American Machinist

Volume 64 New York, May 27, 1926 Number 21

Getting the Most Out of Your Machine Tool Dollar

Out of all our experience, and after all our thought about it, we are convinced that we cannot afford not to buy modern equipment

By James E. Gleason
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SEVEN years is the average age of the machine equipment in the Gleason Works. Having been in existence since 1865 naturally our plant contains some old machines, operated on jobs where set-up and idle time predominate. The fact that the average age of the equipment, in spite of these old machines, is only seven years, speaks for our belief in modern machine tools.

Machines are added to the equipment as they become necessary to enable us to fill our orders, and replacements are made to reduce manufacturing costs.

To determine whether or not additional equipment is needed we check our production program from time to time, the intervals between checkings depending upon the volume of business we have. With a given time to get out a known volume of business, it is not difficult to decide that more equipment is or is not needed.

In buying equipment for either additional capacity or for replacement the expected life of the firm must be considered. The owners of a manufacturing business, well-established on a permanent basis, with a well-filled program assured for several years to come, will undoubtedly be wisest to purchase new machines of the best makes, rather than used machines or machines of a class admittedly less than the best. Decisions made on the basis of permanent employment of plant equipment might rightfully be reversed entirely if it were discovered that the business was to be of only a temporary nature.

How Far Can Replacement Go?

Especially in regard to obsolete equipment do we have to consider the question, "How far can a concern go in replacing machines that any measure of obsolescence might mark for abandonment?" The point of view of every concern will vary according to its manufacturing program; the more work there is ahead, the better can the concern afford to discard machines that are worn out, inferior to a later design, or superseded by new inventions.

The Gleason Works, because of its permanency, is in position to buy the best equipment available and to take advantage of the longer period of time over which to spread depreciation; that is, longer than may be allowed to the concern with a business of a temporary nature, which must gamble investment in equipment against the uncertainty of future business, changes in product, and even dissolution. We are not obliged to consider only our immediate program, or the program for a few months in advance, but can look far ahead.

In spite of the advantages resulting from permanency, we do not feel that we can rightfully set a rigid time limit for the return of investments in equipment. There are other things to consider, such as the quality of the product and the ease and convenience of operation. The nearest we can come to setting a time limit is to say that equipment must pay for itself within a short period of years.

Points Considered in Replacing

Our costs are determined by the amount of time consumed in performing the operations and the cost records are maintained on a machine-tool hour basis. First consideration, therefore, is given to the *speed of production* in determining whether or not to replace a machine. If we can obtain a machine that is enough faster than the one already in use, we discard the old in favor of the new. How much faster the new machine must be depends upon the operation and the cost of the machine. On some operations, where the work is small and the machines light and inexpensive, a saving of 10 per cent is sufficient. On other operations the savings necessary to justify changes vary from 10 to 50 per cent.

Everywhere in industrial work there is a demand for *better quality*, and if we can secure equipment that will so improve the quality of our product as to enable us to secure additional business, we are justified in abandoning equipment even though it is not worn out.

After we have considered the machines with respect to speed of production and improved quality of product, it is necessary to make a detailed study of *items of expense*, such as depreciation, horsepower and floor space required, amount of attention demanded of the operator,

and probable cost of repairs. These items go to make up a cost per hour, which may well be the determining factor in deciding whether or not to replace the machine. Repairs are especially important, not only because of the money spent in labor and material to put the machine in order, but because of the time lost in the interruption of production. The amount of attention demanded of the operator varies greatly between machines of different design, even when they are used to perform the same operation. Often machines have been designed to produce the same product with considerably less floor space and with a great saving in the horsepower required, when compared with other machines. However, not too much emphasis should be placed on smaller power requirements, because expenditures for power constitute only a small part of the cost of production, and it is far better for a machine to be over-powered than under-powered.

Two Kinds of Idle Time

The factor of *idle time* enters into our consideration, because not all of our machines operate continuously. Certain machines are idle for a considerable part of the day, being used on operations that, while essential, are very short, compared to the operations performed on the major part of the equipment. A new machine may have great comparative speed of production, it may be able to produce parts of equal quality, but if it is to stand idle a large portion of the time, the cost of that idleness may more than offset any saving during its operating time.

Idle time, then, resulting from lack of work, is an influence against replacement. The idle time caused by break-down is just as strong an influence in favor of replacement, and it is necessary, therefore, to know the cost of repairs. We do not maintain a repair cost record with the costs distributed against the individual machines, because that system does not seem to be necessary in our plant. But the individual items of expense for repairs are labeled with the numbers of the machines on which they were incurred, so that at any time we can compile a total cost of repairs for any machine from the time it was received in the plant. When it appears that a machine is down more than it should be, the records are examined if we need confirmation of our suspicions. Perhaps I can best explain our feeling that a record showing the repair expenses for each machine would be unjustified, by pointing out that our foremen and the heads of the methods and tools, manufacturing, and production departments come into such close contact with the machines that they know just what they are doing and need records only to enable them to express their knowledge in dollars and cents.

For the machines that we buy, we lean strongly toward the individual motor drive. We like the added flexibility that it gives, enabling us the more readily to expand and contract departments. It permits more light to reach the work, both day and night, adds to the appearance of the shop, and makes for cleanliness. Greater ease of operation is obtained, particularly on account of the electric start, stop, and jog systems now applied to most electrically driven machines. On many machines individual motor drive is more expensive than group motor drive, but again it must be borne in mind that power cost is not an inordinately high percentage of total cost of production. If power cost must be held down, it is possible that the use of ball and roller bearings on the equipment will be of assistance. Our tendency is to increase the use of both on our own product.

The ordinary requests for additional and replacement machines result from the checkings of our production program, which is set by the production department. The program establishes a machine-tool load and there must be enough equipment to meet it. Any one or all of the three departments immediately affected by machine-tool capacity may then find shortages that will result in requests for equipment, which will be presented to the works manager, to whom the superintendents of the three departments report. These departments are (1) production, (2) manufacturing, and (3) methods and tools. Each is subdivided into lesser departments of which those affecting the acquisition of equipment are: (for the production department) work control, dispatching, repairs; (for the manufacturing department) the shop machining departments; and (for the methods and tools departments) methods, experimental and development, tool design, tool making, tool and cutter sharpening, and upkeep.

The works manager decides upon the machines to buy. He is helped to reach his conclusions by means of conferences with equipment salesmen, the engineering representatives of the equipment builders, inspection of the machines in operation in other plants, visits to the plants of the equipment manufacturers, and consultation with our own shop men and executives. He then makes requisition on the purchasing department to issue the formal order.

Details Referred to Man Directly Interested

In buying machine tools it is our policy to have each phase of the examination and consultation taken care of by the man directly interested. The mechanical man looks to the mechanical details and the purchasing agent handles the work in his province, such as terms and delivery dates. When the engineering representative of the machine tool builder visits us he talks to the mechanical man directly interested, whether foreman, superintendent or works manager. In this way we have a temporary machine tool committee formed automatically. It may consist of one man, or several, but it does not take up the time of men not directly interested and it is disbanded as soon as its work is done. Special committees are sometimes appointed to examine one or more machines to report upon their efficiency.

Information concerning equipment of advanced or new design comes to us by way of the technical press and salesmen, and through our close contact with other machine tool builders. We know that we must reach out for all the equipment information that we can get in order to keep our plant up to date.

The disposal of discarded equipment affects the buying of new. We try to sell the old machines with delivery dates that will permit us to take them from their positions in the shop just before the new machines are moved in. The selling of discarded equipment is handled by our sales manager. He may sell the machines direct to customers, to whom he sends lists of used machines as they become available, or he may dispose of them through machinery dealers. Practically none of our discarded machines have reached the condition of being nothing but scrap. Most of them are still economically serviceable under other conditions. We think that our method of disposing of used equipment is consistent with our policies concerning machines

of our own make used by other manufacturers. We do not accept used machines as trade-in. If we consider that a machine has further genuine value, we advise the customer to sell it and give him the names of prospective buyers when available. If we consider that the machine has only scrap value, we buy it, if we can, at the market price of scrap, and put it under the hammer.

The details that I have given cover the most important phases of our equipment policy. From them it may be seen that the equipment problem is one demanding both mechanical and business judgment, and that the decision in regard to any one machine may apply to that machine only. In our factory quality is a dominating influence. Power costs are a minor consideration. Some of our machines require high-priced labor, while others are entirely automatic. We look at our problem from the "long-life" viewpoint. Out of all our experience, and after all our thought about it, we are convinced that we cannot afford not to buy modern equipment.

[The preceding article is the seventeenth under the title, "Getting the Most Out of Your Machine Tool Dollar." The first article, by J. A. Smith, General Superintendent of the General Electric Co., Schenectady, N. Y., was published on page 409, Vol. 62. The second, by C. A. Shaffer, General Supervisor of Machinery and Tools of the Illinois Central Railroad, was published on page 521, Vol. 62. The third, by Robert F. Runge, Vice-president of SKF Industries, Inc., was published on page 719, Vol. 62. The fourth, by L. C. Morrow, Managing Editor, *American Machinist*, outlining the policies of the International Harvester Co., was published on page 793, Vol. 62. The fifth, by G. T. Christopher, Factory Manager, the Dayton Engineering Laboratories Co., was published on page 907, Vol. 62. The sixth, by D. C. Wright, of the H. W. Caldwell & Son Co. plant of the Link-Belt Co., was published on page 1, Vol. 63. The seventh, by T. C. Vail, superintendent, the Spicer Manufacturing Co., was published on page 175, Vol. 63. The eighth, by E. R. Norris, director of works equipment, the Westinghouse Electric and Manufacturing Co., was published on page 255, Vol. 63. The ninth, by Fred H. Colvin, Editor, *American Machinist*, was published on page 417, Vol. 63. The tenth, by Wm. Bailey, production manager, the Hoover Co., was published on page 917, Vol. 63. The eleventh, by G. S. McKee, assistant factory manager, the Timken Roller Bearing Co., was published on page 995, Vol. 63. The twelfth, by Wm. Hartman, superintendent, the National Cash Register Co., was published on page 1, Vol. 64. The thirteenth, by Percy S. Brown, works manager, the Corona Typewriter Co., Inc., was published on page 183, Vol. 64. The fourteenth, by M. H. Westbrook, shop superintendent, Grand Trunk Railway System, was published on page 261, Vol. 64. The fifteenth, by Jerome R. George, vice-president, Morgan Construction Co., was published on page 381, Vol. 64. The sixteenth by W. S. Graham, works manager, the Hupp Motor Car Corporation, was published on page 697, Vol. 64. Other articles on the same subject will be published in forthcoming issues.]

Current Developments in American Business

An abstract of Secretary Hoover's address before the 14th Annual Meeting of the Chamber of Commerce of the United States

THERE is a marked change during this last 25 years in the attitude of employers and employees toward wages and conditions of labor, especially in the larger units of production and service and the larger trades unions. It is not so many years ago that the employer considered it was in his interest to use the opportunities of unemployment and immigration to lower wages irrespective of other considerations. The lowest wages and longest hours were then conceived as the means to attain lowest production costs and largest profits. Nor is it many years ago that our labor unions considered that the maximum of jobs and the greatest security in a job were to be attained by restricting individual effort.

But we are a long way on the road to new conceptions. The very essence of great production is high wages and low prices. It depends upon a widening range of consumption from high real wages and increasing standards of living. Today the majority of employers in times of desperation exhaust every device to make ends meet before resorting to wage reduction. They turn to labor-saving machinery, to constant research for better processes and better administrative methods. In turn, the pressure of high wages is forcing labor-saving devices and better administration to an extent which often reduces labor costs per unit of production below even those of the cheaper labor abroad. There is no more profound proof of labor saving than the fact that we today use roughly 55 million hp. in industry where we used 13 million a quarter of a century ago, and even that omits the increase in power for transportation. Nor are these labor-saving methods developing harder conditions of labor, for the hours of labor have been steadily lessened.

Parallel with this conception there has been an equal revolution in the views of labor.

No one will doubt that labor has always accepted the dictum of the high wage, but labor has only gradually come to the view that unrestricted individual effort, driving of machinery to its utmost, and elimination of every waste in production are the only secure foundations upon which a high real wage can be builded, because the greater the production the greater will be the quantity to divide.

Our original trade unions sprang from the old world labor movement and naturally adopted its conceptions. But the demonstration of the enormous distance which our organized labor has traveled from the tenets of the old world needs no further proof than the new vision of wage crystallized by the American Federation of Labor at its last annual meeting. The background of those proposals is an urge for improved methods, elimination of waste, increase of production, and participation by labor in the resulting gains.

The acceptance of these ideas is obviously not universal. Not all employers, not all businesses have these conceptions, nor has every union abandoned the fallacy of restricted individual effort as the basis of service. But the tendency for both employer and employee to think in terms of the mutual interest of increased production has gained greatly in strength. It is a long cry from the conceptions of the old economists. And it has all contributed profoundly to improvement in the whole basis of employer and employee relationship over a large area of industry, and to the constant growth of national efficiency.

Another marked tendency of the last 25 years is the notable growth of a higher sense of co-operation in the whole community. It is true enough to say that the modern system of fine division of labor and specialization in business is in essence co-operation itself; it is however unconscious co-operation. What I refer to is conscious co-operation.

It is true also that a quarter of a century ago we were adept enough in co-operation for abuse in control of price and of production. But we have gradually evolved a co-operation that is of positive public service.

The last quarter of a century has seen a vast growth

of associational activities—chambers of commerce, trade associations, professional associations, labor unions, trade councils, civic associations, farmers' co-operative associations, all numbering into the thousands, until there is scarcely an individual in our country who does not belong to more than one of them. These associations have grown up with various objectives. Some, a minority, are selfish and narrow. They all represent a vast ferment of conscious co-operation. The great majority today have a recognition of their public responsibilities, as well as the protection of their own interest. They represent a movement toward a more efficient, more ethical business practice and a better synchronizing of the parts of the economic machine.

There are still many wastes induced by destructive competition which need the searching activities of our associations. I need only cite as an example the great waste in return and cancellation privileges in the sale of goods in the wholesale trades. Nor are these wastes to be conquered by legislative regulations—you cannot catch an economic force with a policeman. But we can make progress by co-operation, and with every lift in the level of competition, self-government in business becomes stronger, and competition no less preserved.

Competition Is Necessary

I am one who believes strongly that full constructive competition must be preserved in the manufacture and distribution of commodities. The virility and strength of our whole economic system springs from spontaneous enterprise and the stimulation of competition. It is the impulse of invention and improvement. But competition does not necessarily imply destructive competition. It does imply that we must maintain a sufficient number of independent units in any given industry to assure us that the fundamental competition is sustained. Mass production industries do not necessarily imply trusts and monopolies.

The essential question after all with regard to a unit is whether it is subjected to effective competition, not the size of it. What we sorely need is thoughtful consideration directed to the essential question of how to maintain real competition instead of legalistic formulas, how to substitute constructive competition for destructive competition. The whole process of combination should be weighed solely in the scales of public interest.

Another strong advance in the past quarter of a century has been the increasing stability of credit. One of the terrors of commerce and industry a quarter of a century ago was that variety of slump which arose from inflexible currency and credit or from the malign influence upon credit of over-expansion and speculation. The fundamental business of producing goods and distributing them was thus brought into periodic crises from no fault of either producer or consumer.

Federal Reserve System Stabilizes Credit

The creation of the Federal Reserve System has greatly contributed to reduce these storms. In addition to the flexibility given to currency and credit, the system has greatly minimized the former disturbances arising from the necessity of clearing through a few financial centers. Moreover, the growth of investment capital in the West has to a considerable degree freed Western business from dependence upon the East for new capital resources.

There is a further direction in which commerce and industry is securing freedom from the ebb and flow of credit. Not many years ago practically all industry borrowed money from the banks with which to finance its raw materials and conversion, and the credits which it must extend to its consumers. Today a considerable portion of industry finances its entire working capital from its own resources. The net result of all these changes is to give more stability to production, consumption and employment.

The cumulative value of intensified education, both elementary and higher, which we have been dinning into the American youth this last thirty-five years is immeasurable. During this time we have multiplied our students in institutions of higher learning by 400 per cent. Today we have more than all the rest of the world put together. We have increased the technical personnel in every avenue of production and distribution upon a scale vastly larger than any other nation. The expert has passed from the land of derision to the land of esteem. We have realized from this and many other causes great advances in quality of leadership, in technology, organization and adaptability to new ideas and to shifting demand. Our whole people have increased in education and skill.

We have in this quarter of a century through the government and through private initiative vastly expanded our system of business information. Statistics are now available on production, distribution, stocks, credits, employment, prices and a thousand other phases which make for more intelligent judgment in the conduct of business. Nor is it apart from this phase of discussion to mention the powerful stimulus which all these forces have given to the creation of initiative and leadership in industry and commerce. At no time in history has this leadership been more virile than today in America.

Man Is Better Off With the Products of Machine Production Than Without Them

From the savings made by greater efficiency in production we have added the automobile and the good road, the movies, the radio, and the phonograph directly to the standards of living. We have increased the diffusion of electric light, power, telephone, plumbing and a dozen other things. Some feel that in all this we are deadening the soul of men by machine production and standardization. I haven't time to go into this question, but I may observe that the man who has a standard automobile, a standard telephone, a standard bathtub, a standard electric light, a standard radio, and 1½ hours less average daily labor is more of a man and has a fuller life and more individuality than he has without them.

He would be a rash man who would state that we are finally upon the golden stairs to the industrial millenium, but there is great hope that America is finding herself upon the road to a solution of the greatest of all her problems. That is, the method by which social satisfaction is to be attained with the preservation of private industry, or initiative, and a full opportunity for the development of the individual.

It is true that these economic things are not the objective of life itself. If by their steady improvement we shall yet farther reduce poverty, and create secure and happy homes, we shall have served under God to make better men and women.

Grinding Sewing Machine Shafts on the Centerless Grinding Machine

By Henry Densmore

Accurate grinding of shafts with keyways at end—Shafts ground to 0.002 in. oversize before keyway is cut—Shafts straightened after hardening—An automatic feeding device

THE centerless grinding machine is well established as a production machine to handle any work within its limitations at a rate that cannot hope to be attained upon any machine in which the work-piece must be mounted upon and demounted from a pair of supporting centers. Though the limitations of this machine have been shrinking rapidly since the process was first introduced as a commercial possibility, now but a few years ago, shafts or rods of small diameter having relatively large keyways are admitted by even its most enthusiastic proponents to be a difficult proposition when roundness and accuracy of size are essential requirements.

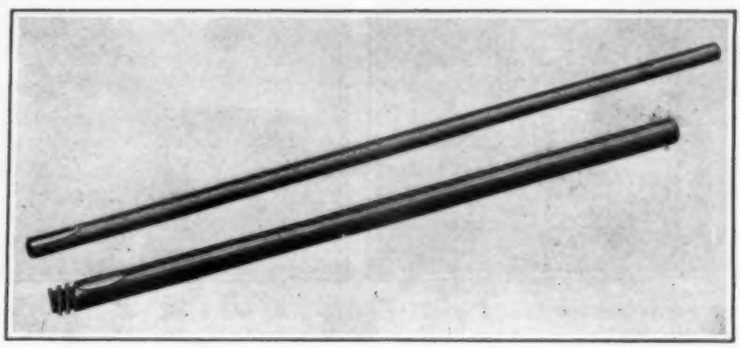

Fig. 1—Some shafts to be ground

Among the parts that go to make up the sewing machine as manufactured at the Bridgeport plant of the Singer Manufacturing Co. there are a number of such shafts, some of them having keyways, grooves, threads and other breaks in the continuity of the circumference located at the extreme end. Such parts have until recently been ground upon centers, as it did not seem to be possible to reduce them to a uniform diameter otherwise. Now, however, they are regularly ground upon the centerless machine at a cost that is greatly lessened by the increased rate of production as well as by the elimination of the centering operation.

Two of the parts that it seemed to be impractical to grind are shown in Fig. 1, one of them being a rod $\frac{7}{16}$ in. in diameter with a deep and wide V-shaped groove at one end, the other a shaft somewhat larger in diameter with three turns of a square-sectioned thread in the same inconvenient location. The requirements in each case are true roundness and accuracy of diameter to within 0.0002 inch.

Though the centerless grinding machines were regularly producing other shafts of similar dimensions, some of them having grooves or keyways at one part or another of their length, and meeting the same requirements, experiment seemed to demonstrate that the pieces here shown could not be produced satisfactorily in the same way. The grooved or threaded end would be very badly out of round when the piece came from the machine, regardless of the means adopted to prevent such condition.

Almost any mechanic, whether or not he was familiar with the centerless grinding machine, would say that the end of the piece having the unbroken circumference should lead; the theory being that the shaft would already be ground true and to size over the greater portion of its length by the time the thread or groove reached the grinding point and therefore the piece would be steadied by the wheels while the irregular surface was being ground. This, however, was just what did *not* happen. No matter how nearly perfect the grinding may have been just before the piece was ejected from the machine, the end was most certainly not round when it came out.

The material of which the shafts are made is mild steel and the parts are necessarily pack-hardened. Experiments were tried upon both hardened and soft shafts, with different numbers of passes through the machine, and with much as well as with little material to be removed in the final pass; always with discouraging results. It was not until the piece was turned around and the end with the interrupted circumference allowed to lead that the engineers discovered that they were on the right track.

The centerless machine now grinds both of these parts to the required degree of accuracy as a matter of everyday practice. Something more than the mere reversal of the piece was necessary however, before success was assured. The shafts are now ground to 0.002 in. oversize before the groove or the thread is cut, and after these necessary machining operations are performed the shafts are pack-hardened by a process that is designed to prevent warping or bending as far as is possible; though no amount of care in this

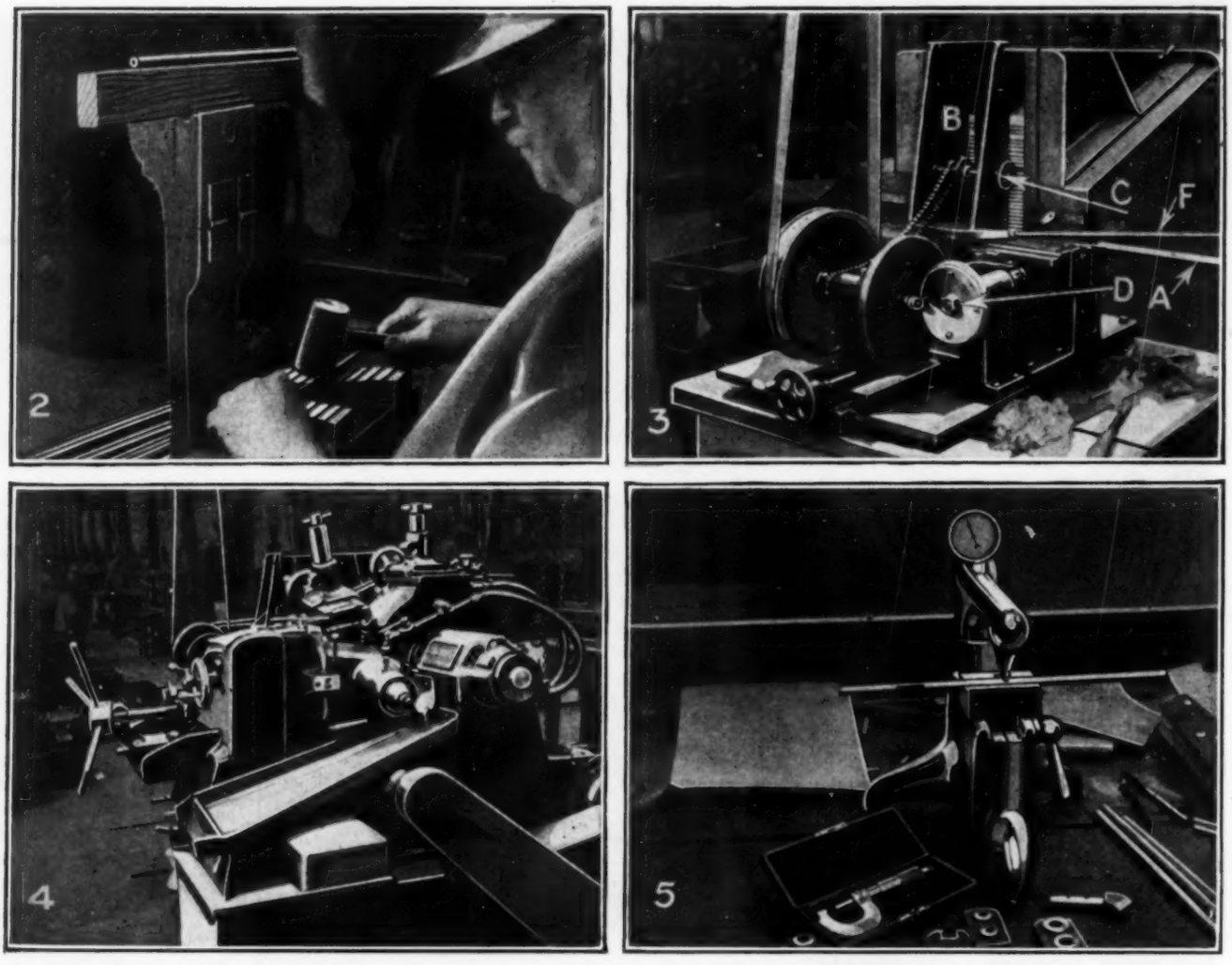

Fig. 2—Straightening hardened shafts. Fig. 3—The feeding machine. Fig. 4—The Cincinnati centerless grinding machine. Fig. 5—Part of inspection bench

respect will bring them out straight enough to finish within the small allowance.

Before going to the grinding machine the shafts pass through a straightening operation, performed as shown in Fig. 2 by workmen who soon become expert in taking out whatever kinks and winds may be introduced in the hardening process. The equipment for straightening consists of a special anvil that may be seen in the illustration; a soft hammer; and a hardened steel parallel having one narrow side ground accurately straight and highly polished. The parallel is supported on the bench by a post in such position as to bring its straight edge level with the workman's eyes.

As the shaft lies upon the polished straight edge any departure from straightness is made conspicuously apparent by the irregular line of light between it and its support. By turning it about with his fingers the workman discovers where the high spots are, transfers the piece to the anvil and corrects the errors with a few judicious taps of the hammer. Though straightening a piece that may be 12 in. long to a limit of error of not more than 0.002 in. may seem to the uninitiated to be a job difficult of accomplishment it is not so in fact. After a little experience the workman is able to straighten the pieces with creditable rapidity.

The secret of accurate sizing in the case of these shafts that have an interrupted circumference at one end seems to lie in having the faces of the abrasive wheels, measured along the lines of contact with the work, converge slightly toward the side from which the work is ejected. The departure from parallelism is very slight, and is secured by a corresponding adjustment of the wheel truing diamonds. With the grooved end of the work leading the piece is supported by the whole face width of the wheels while the interrupted surface is being ground and there can be no variation or shifting of the center of the work during its passage.

A vitrified alundum wheel of 60 grain, grade L, is used on the machine to grind these shafts, and the controlling, or regulating, wheel is a hard elastic bond wheel of 80 grain alundum. As many as 2,400 pieces have been passed through the machine before it was necessary to redress the wheels.

Though there is an operator in constant attendance upon the machine during a run, his duties are mainly confined to gaging an occoasional piece as it comes from the machine and making a slight readjustment of the wheel setting if the piece tends to run oversize. It is not necessary to stop the flow of work for the purpose.

The feeding device, shown in Fig. 3, takes the shafts from a hopper and pushes them through the V-shaped trough *A* to the grinding machine. Though there may be several pieces in the trough between the feeder and the machine, the number depending upon the length of

the pieces, each piece pushes the one ahead of it until the foremost piece enters between the wheels. The rate at which the feeder ejects the pieces is set to be slightly less than the rate of traverse of the work through the grinding machine, so that as each piece is taken up in turn by the wheels it runs ahead of the string of following pieces in the trough. When it leaves the machine it may be ¼ in. or so ahead of the next piece; close enough to avoid loss of time and yet not so close as to allow the following piece to crowd it.

In the feeder the shafts are placed in a hopper, the inclined bottom of which causes them to bear against the vertical face of the large angleplate *B*, Fig. 3, where they are agitated by the slow revolution of the chain-driven disks *C* with one projecting tooth in each. This prevents the parts from "hanging up," and there is always a stack of them in the channel between the angleplate and the back of the hopper. The shaft at the bottom of the stack rests upon a continuously moving endless chain that is traveling toward the grinding machine in a direction parallel to the shafts.

Time-Saving Arrangement

The center links of the chain are each drilled to take a short peg, which is removable. Pegs are set only in those links that are at a distance apart corresponding to the length of the piece to be ground. For very short pieces there might be a peg in each link; for long ones but two or three pegs in the length of the chain are needed. The object of setting the pins in the chain as closely as the length of the pieces will allow is to keep the procession of work moving without loss of time by reason of long intervals.

The sprocket from which the chain derives its movement is keyed to the shaft upon the opposite end of which the rubber-tired wheel *D* is secured. By pressing this wheel against the revolving disk *E* at a point nearer to or farther from the center of rotation of the latter the speed at which the work is delivered may be regulated.

The control rod *F* reaches over to the grinding machine so that the operator thereof can, without changing his position, govern the rate of progress of the string of pieces in the trough. The control rod also stops and starts the feeder at will of the operator by means of a clutch. Fig. 4 shows the Cincinnati centerless grinding machine set up for this job of shaft grinding.

Convenient to the operator's position is the inspection bench, a part of which may be seen in Fig. 5, with the gages and testing devices by means of which he is enabled to keep a close watch upon the size and uniformity of the product of the machine. The dial of the indicator on the roundness testing device is connected to the measuring spindle through a lever of 10:1 ratio so that a very minute error is magnified to easily readable proportions.

Machines are sometimes put on trial with a guaranty that the builder knows cannot be met. He hopes, however, to sell the machine by making a reduction from the original price asked. The buyer would perform a service, both to himself and the machine tool industry, by rejecting all such machines at any price. As long as builders of this character are encouraged, the worth of guaranties is jeopardized for all concerned. If buyers will encourage builders with a reputation for square dealing by discouraging the other kind, all will benefit.

Seen and Heard

By John R. Godfrey

Hooking Up the Shop with Sales

ONE of the principles of my good old friend, the late Frank Gilbreth, was that every man nust have some one trained to take his job before he could expect a better one. And there's a lot more to that principle than appears on the surface.

First of all you've got to make a man see that he isn't working himself out of a job when he shows the man under him or next to him the methods and knack of doing things that he has taken years to learn. This condition puts it up to the boss to play fair with all hands and no favorites, relatives or otherwise.

Then you must make every one see that his is a real job, that he has something to pass on to the next man, as well as that he must learn about the job higher up. When the foreman begins to teach the man at the bench about his own job and also begins to see what the general, or department foreman has to know, he can't help learning things about the business that he never knew before. And the more every man in the plant knows about the things he is making, the better for the plant.

All of these things make a man think more about his job and the product. And the more the man in the shop thinks about the product, the easier it is for the sales department. It sort of makes the shop a part of the sales force, even though the men don't go out and solicit orders. Interest in the job and the product has done more to build up and maintain reputations for reliable products than many appreciate. When every man is proud to be connected with any organization, you can bet on the product being among the best in the field.

Some concerns make the mistake of expecting this sort of feeling without doing anything to deserve it. When the good positions are filled by outsiders without giving men in the shop a chance, the feeling of loyalty sort of gets a set-back. Loyalty has to work both ways. Of course, there are times when any organization has to go outside for men—and it's frequently a good plan to get a little new blood; helps to liven up the old if it's of the right kind. But it is better to be perfectly frank about it, and say you'd rather have taken a man from the inside but couldn't find just the man for that special job—or that the new man has had experience that will help the organization.

I don't know of a better way to stimulate interest, however, than the Gilbreth formula, mentioned at the beginning. Get every man in the shop to thinking that there's a better job ahead when he is ready for it and when there's an opening. Get every man to trying to learn about the next job ahead, and he'll be very glad to teach the man below or beside him all that he knows about his own job. This incentive means team work of the best kind, and team work, in the broad sense, pays good dividends. It hooks the shop and the sales force together in a way that helps all hands.

In drilling, there is a great tendency for laminated work, such as pole pieces, to creep while being drilled. To avoid this, one company welded the edges together after assembly, using the electric arc.

Tentative Standards for Stock Taper Keys

TENTATIVE standards for plain and gib-head stock taper keys have been prepared by Sub-committee No. 4 and submitted to the Sectional Committee on the Standardization of Shafting of the American Society of Mechanical Engineers.

These proposed standards are published in the *American Machinist* for purposes of discussion and criticism. Communications should be addressed to C. B. Le Page, Assistant Secretary, The American Society of Mechanical Engineers, 29 West 39th St., New York City.

In Table III is shown six standard stock lengths for each key size of either type corresponding to the eleven selected ranges of shaft diameters. For each length the height of the key at *W* inches from the large end is the same and the height at the small end is determined by the standard taper of $\frac{1}{8}$ in. per foot.

Table I—Dimensions and Tolerances for Tentative Standard Plain Taper Keys

Diameters of Shafts (Inclusive)	Square Type: Maximum Width *W*	Square Type: Minimum Height Large End* *H*	Flat Type: Maximum Width *W*	Flat Type: Minimum Height Large End* *H*	Tolerances: Width (Minus)	Tolerances: Height (Plus)
$\frac{1}{2}$ – $\frac{9}{16}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{5}{32}$	0.0020	0.0020
$\frac{5}{8}$ – $\frac{7}{8}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{1}{8}$	0.0020	0.0020
$\frac{15}{16}$–$1\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{3}{16}$	0.0020	0.0020
$1\frac{5}{16}$–$1\frac{3}{4}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{1}{4}$	0.0020	0.0020
$1\frac{13}{16}$–$2\frac{1}{4}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{5}{16}$	0.0025	0.0025
$2\frac{5}{16}$–$2\frac{3}{4}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{7}{16}$	$\frac{3}{8}$	0.0025	0.0025
$2\frac{7}{8}$ –$3\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{7}{16}$	0.0025	0.0025
$3\frac{5}{16}$–$3\frac{3}{4}$	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{1}{2}$	0.0030	0.0030
$3\frac{7}{8}$ –$4\frac{1}{2}$	1	1	1	$\frac{3}{4}$	0.0030	0.0030
$4\frac{3}{4}$ –$5\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{4}$	1	0.0030	0.0030
$5\frac{3}{4}$ –6	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{2}$	1	0.0030	0.0030

*The thickness of the key is measured at the distance *W* from the large end. All dimensions are in inches.

Table III—Tentative Standard Stock Lengths for Plain and Gib-Head Taper Keys

Diameters of Shafts (Inclusive)	Length of Key, L, Inches						
$\frac{1}{2}$ – $\frac{9}{16}$	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2
$\frac{5}{8}$ – $\frac{7}{8}$	$\frac{3}{4}$	$1\frac{1}{8}$	$1\frac{1}{2}$	$1\frac{7}{8}$	$2\frac{1}{4}$	$2\frac{5}{8}$	3
$\frac{15}{16}$–$1\frac{1}{4}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4
$1\frac{5}{16}$–$1\frac{3}{4}$	$1\frac{1}{2}$	$2\frac{1}{4}$	3	$3\frac{3}{4}$	$4\frac{1}{2}$	$5\frac{1}{4}$	6
$1\frac{13}{16}$–$2\frac{1}{4}$	2	3	4	5	6	7	8
$2\frac{5}{16}$–$2\frac{3}{4}$	$2\frac{1}{2}$	$3\frac{3}{4}$	5	$6\frac{1}{4}$	$7\frac{1}{2}$	$8\frac{3}{4}$	10
$2\frac{7}{8}$ –$4\frac{1}{4}$	3	$4\frac{1}{2}$	6	$7\frac{1}{2}$	9	$10\frac{1}{2}$	12
$3\frac{5}{8}$ –$3\frac{3}{4}$	$3\frac{1}{2}$	$5\frac{1}{4}$	7	$8\frac{3}{4}$	$10\frac{1}{2}$	$12\frac{1}{4}$	14
$3\frac{7}{8}$ –$4\frac{1}{2}$	4	6	8	10	12	14	16
$4\frac{3}{4}$ –$5\frac{1}{2}$	5	$7\frac{1}{2}$	10	$12\frac{1}{2}$	15	$17\frac{1}{2}$	20
$5\frac{3}{4}$ –6	6	9	12	15	18	21	24

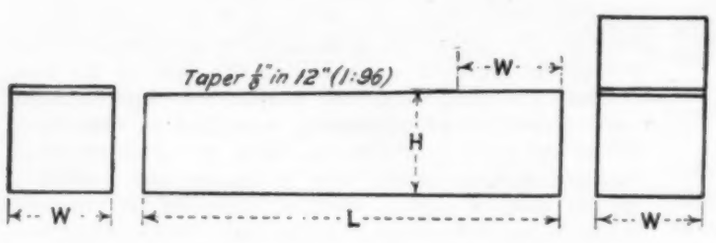

FIG. 1

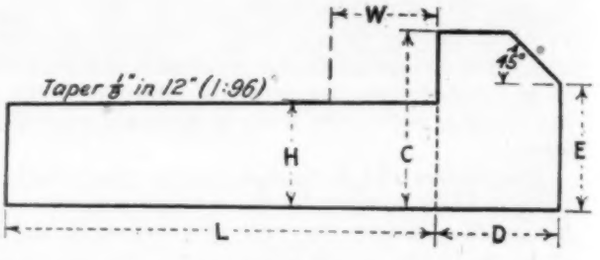

FIG. 2

Table II—Dimensions and Tolerances for Tentative Standard Gib-Head Taper Keys

Diameter of Shafts (Inclusive)	Square Type: Key: Maximum Width *W*	Square Type: Key: Minimum Height Large End* *H*	Square Type: Gib Head: Height *C*	Square Type: Gib Head: Length *D*	Square Type: Gib Head: Height Edge of Chamfer *E*	Flat Type: Key: Maximum Width *W*	Flat Type: Key: Minimum Height Large End* *H*	Flat Type: Gib Head: Height *C*	Flat Type: Gib Head: Length *D*	Flat Type: Gib Head: Height Edge of Chamfer *E*	Tolerances on Keys: Width (Minus)	Tolerances on Keys: Height (Plus)
$\frac{1}{2}$ – $\frac{9}{16}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{7}{32}$	$\frac{5}{32}$	$\frac{3}{8}$	$\frac{5}{32}$	$\frac{3}{16}$	$\frac{1}{2}$	$\frac{1}{8}$	0.0020	0.0020
$\frac{5}{8}$ – $\frac{7}{8}$	$\frac{3}{16}$	$\frac{3}{16}$	$\frac{5}{16}$	$\frac{9}{32}$	$\frac{7}{32}$	$\frac{3}{16}$	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{3}{16}$	$\frac{3}{32}$	0.0020	0.0020
$\frac{15}{16}$–$1\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{11}{32}$	$\frac{9}{32}$	$\frac{1}{4}$	$\frac{3}{16}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{1}{16}$	0.0020	0.0020
$1\frac{5}{16}$–$1\frac{3}{4}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{13}{32}$	$\frac{11}{32}$	$\frac{5}{16}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{1}{16}$	0.0020	0.0020
$1\frac{13}{16}$–$2\frac{1}{4}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{19}{32}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	0.0025	0.0025
$2\frac{5}{16}$–$2\frac{3}{4}$	$\frac{7}{16}$	$\frac{7}{16}$	$1\frac{1}{16}$	$\frac{23}{32}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{7}{16}$	$\frac{1}{2}$	0.0025	0.0025
$2\frac{7}{8}$ –$3\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{2}$	$1\frac{1}{4}$	$\frac{7}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{7}{16}$	$\frac{9}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	0.0025	0.0025
$3\frac{5}{8}$ –$3\frac{3}{4}$	$\frac{5}{8}$	$\frac{5}{8}$	$1\frac{1}{2}$	1	1	$\frac{5}{8}$	$\frac{1}{2}$	$1\frac{1}{16}$	$\frac{5}{8}$	$\frac{3}{4}$	0.0030	0.0030
$3\frac{7}{8}$ –$4\frac{1}{2}$	1	1	$1\frac{3}{4}$	$1\frac{3}{16}$	$1\frac{3}{16}$	1	$\frac{3}{4}$	$1\frac{1}{4}$	1	$1\frac{3}{16}$	0.0030	0.0030
$4\frac{3}{4}$ –$5\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{4}$	2	$1\frac{7}{16}$	$1\frac{7}{16}$	$1\frac{1}{4}$	1	$1\frac{5}{8}$	$1\frac{1}{4}$	1	0.0030	0.0030
$5\frac{3}{4}$ –6	$1\frac{1}{2}$	$1\frac{1}{2}$	$2\frac{1}{2}$	$1\frac{7}{8}$	$1\frac{7}{8}$	$1\frac{1}{2}$	1	$1\frac{7}{8}$	$1\frac{1}{2}$	$1\frac{1}{4}$	0.0030	0.0030

All dimensions are in inches. *The thickness of the key is measured at the distance *W* from the large end.

The Design of Gear Tooth Forms

By Earle Buckingham
Associate Professor of Engineering Standards and Measurements
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The introduction of straight-sided hobs and racks resulted in the 14½-deg. generated gear tooth system—Effect of undercutting on length of contact

IN THE past, the different gear tooth systems have been developed primarily around the method employed to produce them. Thus with the introduction of generating or molding processes, such as hobbing and shaping, new gear tooth systems came into existence. These new systems were influenced at the start by the existing practices. Later, they departed from them to a lesser or to a greater extent in order to obtain greater benefit of the new production processes.

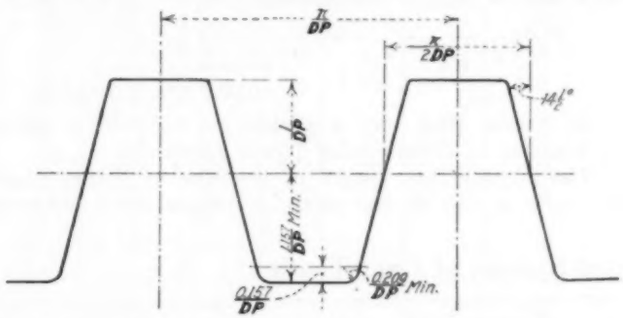


Fig. 44—Basic rack of the 14½-deg. generated system

For example, when hobbing was first introduced, the tooth design followed very closely the tooth design of milled gears, which in their turn had been largely influenced by the design of the teeth of cast gears. The tooth proportions and pressure angle for the hobbed gears remained the same as those for milled gears. The worm-shaped cutter represented the basic rack of the gear system, and because the straight-sided involute rack was the simplest form to reproduce on these cutters, this form was adopted. This method of generation introduced another 14½-deg. gear tooth system with a basic rack of the form shown in Fig. 44. This 14½-deg. generated form will not mesh correctly with the 14½-deg. composite form used for milled gears. It is an entirely distinct gear tooth system.

Analysis of 14½-Deg. Generated Gear System

When the numbers of teeth in the gears are large enough, this system gives excellent results. When the tooth numbers are small, however, excessive undercutting occurs. The following analysis of this gear tooth system should make evident its limitations when small numbers of teeth are involved.

Most gear tooth systems are based on a pinion of twelve teeth as the smallest gear of the system. We will therefore examine first the 12-tooth pinion of this system.

When E = outside radius
R = pitch radius
a = radius of base circle
F = addendum of basic rack, including clearance fillet
f = clearance on generating rack or hob
A = minimum root radius without undercut
H = root radius
α = pressure angle.

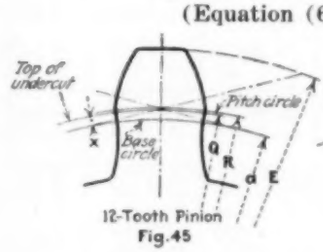
We have the following values for a 12-tooth pinion of 1 diametral pitch:

$E = 7.0000$ in.
$R = 6.0000$ in.
$H = 4.8430$ in.
$F = 1.1570$ in.
$f = 0.1570$ in.
$\alpha = 14\frac{1}{2}°$

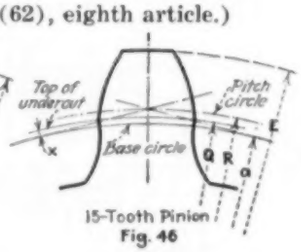
$a = R \cos \alpha = 5.8089$. (Equation (55), eighth article.)
$A = R \cos^2 \alpha - f = 5.4669$. (Equation (60), eighth article.)
e = excess depth beyond undercut limit = $A - H = 0.6239$.
x = radial height above the base circle of undercut part of profile.

$$x = \frac{2.7448e^2}{R} = 0.1781.$$

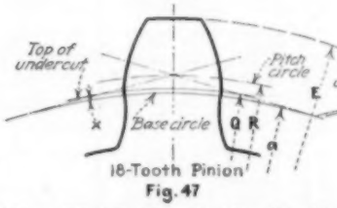
(Equation (62), eighth article.)



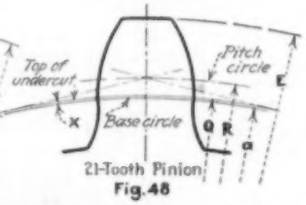
12-Tooth Pinion
Fig. 45



15-Tooth Pinion
Fig. 46



18-Tooth Pinion
Fig. 47



21-Tooth Pinion
Fig. 48

Figs. 45, 46, 47 and 48—Tooth forms of pinions of 12, 15, 18 and 21 teeth respectively of the 14½-deg. generated system

The twelfth article. The thirteenth will appear in an early issue.

The shape of this pinion tooth is shown in Fig. 45. It will be noted that almost all of the involute profile below the pitch circle has been removed. If this pinion engaged with a rack (a condition which would give the maximum contact possible) the amount of contact would be equal to the quotient of the length of the line of action, intercepted between the outside circle of the pinion and the circle through the top of the undercut, divided by the normal pitch. The result would be expressed in terms of tooth intervals.

The length of the line of action from the base circle to the outside circle equals $\sqrt{E^2 - a^2}$ (Equation (57), eighth article.)

Let Q = radius to top of undercut, then

$$Q = a + x$$

and the length of the line of action from the base circle to the circle through the top of the undercut equals $\sqrt{Q^2 - a^2}$.

The length of the line of action, therefore, intercepted between the outside circle and the circle at the top of the undercut equals $\sqrt{E^2 - a^2} - \sqrt{Q^2 - a^2}$.

This length, divided by the normal pitch Pn gives us the measure of the maximum tooth contact possible.

$Pn = \frac{2\pi a}{N}$, where N = number of teeth. (Equation (57), eighth article.) Whence involute contact between a rack and an undercut gear equals

$$\frac{\sqrt{E^2 - a^2} - \sqrt{Q^2 - a^2}}{Pn}$$

In this example, $\sqrt{E^2 - a^2} = 3.9060$ in.

$Q = 5.8089 + 0.1781 = 5.9870$ in.

$\sqrt{Q^2 - a^2} = 1.4503$ in.

$Pn = 3.0415$ in.

Whence contact with a rack equals 0.807 tooth interval.

The length of contact on this pinion is not sufficient to give an overlap even when meshing with a rack.

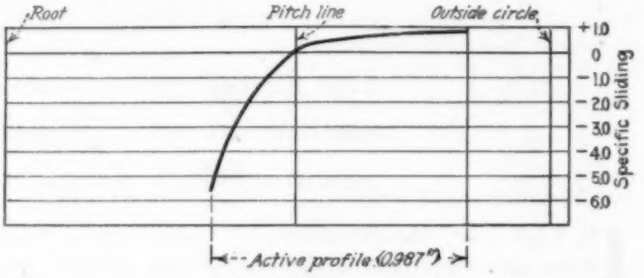


Fig. 49—Specific sliding between two 22-tooth, 14½-deg. generated tooth gears

This contact becomes less where gears are engaged with it and becomes smaller as the number of teeth decreases. Where two of these 12-tooth pinions mesh together the contact becomes equal to:

$$\frac{2(R \sin \alpha - \sqrt{Q^2 - a^2})}{Pn} = \frac{0.1040}{3.0415} =$$

0.034 tooth interval

It is evident that such a pinion has very little value as a means of transmitting power smoothly.

Theoretically the length of the line of action must be equal to the normal pitch, or longer, in order that

Table V—14½-Deg. Generated System of Gear Teeth

Number of Teeth N	Radius of Pitch Circle R	Radius of Base Circle a	Undercut Radius A	Root Radius H	Excess Depth of Cut e	Height of Undercut x	Radius to Top of Undercut Q	Outside Radius E	$\sqrt{E^2-a^2}$	$\sqrt{Q^2-a^2}$	$R \sin$
12	6.00	5.80890	5.46686	4.8430	0.62386	0.17813	5.98703	7.00	3.9060	1.4503	1.5023
13	6.50	6.29298	5.93552	5.3430	0.59252	0.14825	6.44123	7.50	4.0802	1.3748	1.6275
14	7.00	6.77705	6.40417	5.8430	0.56117	0.12348	6.90053	8.00	4.2511	1.2996	1.7527
15	7.50	7.26113	6.87283	6.3430	0.52983	0.10274	7.36387	8.50	4.4188	1.2259	1.8779
16	8.00	7.74520	7.34148	6.8430	0.49848	0.08525	7.83045	9.00	4.5839	1.1524	2.0030
17	8.50	8.22928	7.81014	7.3430	0.46714	0.07047	8.29975	9.50	4.7475	1.0794	2.1282
18	9.00	8.71335	8.27879	7.8430	0.43579	0.05792	8.77127	10.00	4.9069	1.0065	2.2534
19	9.50	9.19743	8.74745	8.3430	0.40445	0.04726	9.24469	10.50	5.0653	0.9338	2.3786
20	10.00	9.68150	9.21610	8.8430	0.37310	0.03821	9.71971	11.00	5.2220	0.8612	2.5038
21	10.50	10.16558	9.68476	9.3430	0.34176	0.03057	10.19615	11.50	5.3769	0.7887	2.6290
22	11.00	10.64965	10.15341	9.8430	0.31041	0.02404	10.67369	12.00	5.5304	0.7163	2.7542
23	11.50	11.13373	10.62207	10.3430	0.27907	0.01859	11.15232	12.50	5.6825	0.6441	2.8794
24	12.00	11.61780	11.09072	10.8430	0.24772	0.01404	11.63184	13.00	5.8333	0.5719	3.0046
25	12.50	12.10188	11.55938	11.3430	0.21638	0.01028	12.11216	13.50	5.9829	0.4997	3.1298
26	13.00	12.58595	12.02803	11.8430	0.18503	0.00723	12.59318	14.00	6.1314	0.4275	3.2549
27	13.50	13.07003	12.49669	12.3430	0.15369	0.00480	13.07483	14.50	6.2789	0.3554	3.3801
28	14.00	13.55410	12.96534	12.8430	0.12234	0.00293	13.55703	15.00	6.4255	0.2833	3.5053
29	14.50	14.03818	13.43400	13.3430	0.09100	0.00156	14.03974	15.50	6.5712	0.2118	3.6305
30	15.00	14.52225	13.90265	13.8430	0.05965	0.00065	14.52290	16.00	6.7160	0.1409	3.7557
31	15.50	15.00633	14.37131	14.3430	0.02831	0.00014	15.00647	16.50	6.8601	0.0700	3.8809
32	16.00	15.49040	14.83996	14.8430	0.00000	0.00000	.....	17.00	7.0035	0.0000	4.0061
33	16.50	15.97448	15.30862	15.3430	.....	.....	.....	17.50	7.1461	.....	4.1313
34	17.00	16.45855	15.77727	15.8430	.....	.....	.....	18.00	7.2281	.....	4.2565
35	17.50	16.94263	16.24593	16.3430	.....	.....	.....	18.50	7.4295	.....	4.3817
36	18.00	17.42670	16.71458	16.8430	.....	.....	.....	19.00	7.5704	.....	4.5068
37	18.50	17.91078	17.18324	17.3430	.....	.....	.....	19.50	7.7107	.....	4.6320
38	19.00	18.39485	17.65189	17.8430	.....	.....	.....	20.00	7.8505	.....	4.7572
39	19.50	18.87893	18.12055	18.3430	.....	.....	.....	20.50	7.9898	.....	4.8824
40	20.00	19.36300	18.58920	18.8430	.....	.....	.....	21.00	8.1287	.....	5.0076

Table VI—Length of Contact Between Mating 14½-Deg. Generated Gears in Terms of Tooth Intervals

No. of Gear Teeth	Number of Teeth in Pinion															
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
12	0.034															
13	0.100	0.166														
14	0.166	0.232	0.298													
15	0.231	0.297	0.363	0.428												
16	0.297	0.362	0.428	0.494	0.559											
17	0.362	0.427	0.494	0.559	0.624	0.689										
18	0.427	0.493	0.559	0.624	0.689	0.754	0.819									
19	0.492	0.558	0.624	0.689	0.754	0.819	0.884	0.950								
20	0.557	0.623	0.689	0.754	0.819	0.884	0.949	1.014	1.080							
21	0.622	0.688	0.754	0.819	0.884	0.949	1.014	1.079	1.144	1.210						
22	0.687	0.753	0.819	0.884	0.949	1.014	1.079	1.144	1.209	1.274	1.340					
23	0.752	0.818	0.884	0.949	1.014	1.079	1.144	1.209	1.274	1.339	1.404	1.469				
24	0.807	0.883	0.949	1.014	1.079	1.144	1.209	1.274	1.339	1.404	1.469	1.534	1.599			
25	0.807	0.889	0.970	1.049	1.128	1.205	1.274	1.339	1.404	1.469	1.534	1.599	1.664	1.729		
26	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.794	1.859	
27	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.906
28	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.913
29	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.919
30	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.926
31	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.932
32	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.938
33	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.944
34	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.947
35	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.947
36	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.947
37	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.947
38	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.947
39	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.947
40	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.947
Rack	0.807	0.889	0.970	1.049	1.128	1.205	1.282	1.358	1.433	1.508	1.582	1.656	1.729	1.802	1.875	1.947

the motion may be transferred smoothly from one tooth to the next. In practice it has been found that with a contact less than 1.40 tooth intervals, great care must be exercised in the production of such gears to secure smooth and quiet running. For the quiet transmission of any appreciable amount of power, contact of 1.40 tooth intervals or better should be secured, if possible. As small a contact as 1.20 intervals is used in extreme cases, but this requires extreme accuracy in the gears to secure smooth and quiet running.

The accompanying table gives values for 1-d.p. gears of small tooth numbers, made to the 14½-deg. generated gear system, which establish the amount of undercut and contact.

Figs. 46, 47, and 48 show the forms of 15-, 18-, and 21-tooth gears of this system. Note how the top of the undercut recedes from the pitch circle toward the base circle as the number of teeth is increased.

A second table is given which shows the amount of contact that exists between gears of small tooth numbers made to this system. The values are expressed in terms of tooth intervals.

It will be seen from this table of contact that two 23-tooth pinions are the smallest equal pair that give a contact of 1.40 tooth intervals or more. A 20-tooth pinion with a 25-tooth gear or larger, and a 21-tooth pinion with a 24-tooth gear or larger, and a 22-tooth pinion with a 23-tooth gear or larger will also give this contact. Smaller gears than these give so little contact that their use is questionable.

The amount of contact is but one element of gear tooth design. Sometimes a tooth form with less contact is more favorable for the smooth transmission of power than one with more contact. This is true when the longer contact is obtained by using that part of the involute profile at or very near the base circle. Here the form is very sensitive and very difficult to make accurately because of the small and rapidly changing radius of curvature of the profile.

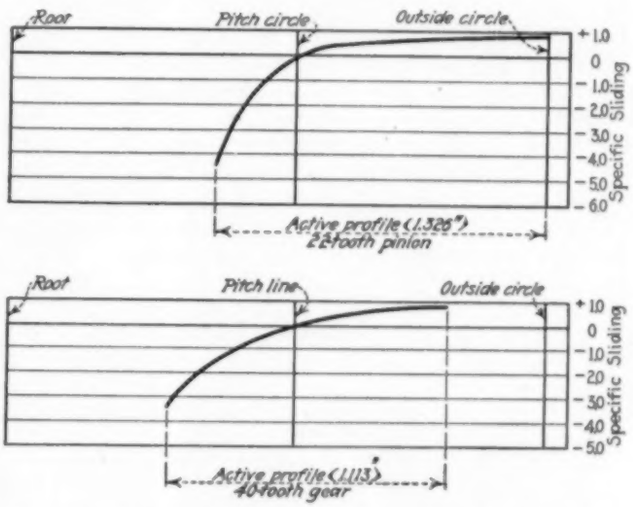


Fig. 50—Specific sliding between a 22-tooth pinion and a 40-tooth gear, 14½-deg. generated tooth system

The information given in the first table enables an analysis of these features to be made readily. For example, we will examine the pair of 22-tooth gears. The minimum radius of curvature of the active profile in this case is at the end of the undercut, and is equal to $\sqrt{Q^2 - a^2}$ which equals 0.7163 in. In many respects, the tooth action here is better with the undercut than it would be without it. The additional contact that would be secured by the elimination of this undercut would be of little value, and the more sensitive profile would be a liability rather than an asset.

The sliding conditions for this pair of gears can also be readily established. We have from the sixth article:

$$\text{Specific sliding on pinion} = \frac{b_1N_2 - b_2N_1}{b_1N_2}$$

$$\text{Specific sliding on gear} = \frac{b_2N_1 - b_1N_2}{b_2N_1}$$

Where b_1 = radius of curvature of any point of tooth profile on pinion

b_2 = radius of curvature of mating point of tooth profile on gear

N_1 = number of teeth in pinion

N_2 = number of teeth in gear.

We know that at the pitch line the specific sliding is zero. We will determine the specific sliding at two other points, the beginning and the ending of contact.

At the beginning of contact, b_1 is equal to the minimum radius of curvature of the active profile, or 0.7163 in., while b_2 is equal to the total length of the line of action minus b_1. In this case, the total length of the line of action is equal to $2R \sin a$, which equals 5.5084 in., whence b_2 equals 4.7921 in. N_2 and N_1 are both equal to 22, and cancel from the equation. Thus we have:

$$\text{Specific sliding at beginning of contact} = \frac{0.7163 - 4.7921}{0.7163} = -5.69$$

The values of b_1 and b_2 are reversed at the ending of contact, whence we have:

$$\text{Specific sliding at ending of contact} = \frac{4.7921 - 0.7163}{4.7921} = +0.85$$

This specific sliding is plotted in Fig. 49.

We will also determine the specific sliding conditions on this same 22-tooth pinion when meshing with a 40-tooth gear. The minimum radius of curvature of the active profile of the pinion is the same as before. The total length of the line of action is equal to the sum of $R \sin a$ for one gear plus $R \sin a$ for the other, which is equal to 7.7618 in. Whence we have for the sliding conditions at the beginning of contact:

$b_1 = 0.7163$ in.

$N_1 = 22$ teeth

$b_2 = 7.0455$ in.

$N_2 = 40$ teeth.

$$\text{Specific sliding on pinion} = \frac{0.7163 \times 40 - 7.0455 \times 22}{0.7163 \times 40} = -4.40$$

$$\text{Specific sliding on gear} = \frac{7.0455 \times 22 - 0.7163 \times 40}{7.0455 \times 22} = +0.81$$

In this case the active profile of the pinion extends to the tip of the tooth, so that at the ending of contact the radius of curvature on the pinion is equal to $\sqrt{E^2 - a^2}$ which equals 5.5304 in. Thus we have for the sliding conditions at the ending of contact:

$$\text{Specific sliding on pinion} = \frac{5.5304 \times 40 - 2.2314 \times 22}{5.5304 \times 40} = +0.77$$

$$\text{Specific sliding on gear} = \frac{2.2314 \times 22 - 5.5304 \times 40}{2.2314 \times 22} = -3.50$$

This specific sliding is plotted in Fig. 50.

Why Expect Brains, If Only Brawn Is Paid For?

BY CLYDE D. THORBURN

The days of intimidating or bullying employees to greater effort are long since past and we must resort to other and more humane means to keep production within a cost that will meet competition. Every reasonable endeavor should be made to make an employee's job interesting to him. We try to surround him with the best of working conditions. Why not go a step further? A man who is interested in his work is not usually a clock watcher. One way of increasing an employee's interest in his work is to increase the contents of his pay envelope when profitable results are obtained from any suggestions that he may make.

There is a very large field for suggestions in almost any of the large plants, especially where a lot of mechanical operations are performed. The problem is to find the best means for securing these suggestions. Some employees are very prone to keeping their ideas to themselves because they fear that an improved method may have some adverse effect upon their earnings. In a locomotive machine shop, for example, where the various mechanical operations are very numerous and are repeated thousands of times, we find operators doing routine operations in the same old way, day in and day out. Something has to be injected into these men to make them think a little beyond their regular routine, and every possible encouragement should be given them by those in immediate charge to develop individual initiative.

The gain is mutual for both employer and employee. In so far as the extra pay is concerned, the employer pays only for profitable results, and what can be more encouraging to the employee than to receive a little "brain" money in his pay envelope? At one time a letter of appreciation, from someone in high authority, was considered very pleasing to the recipient but nowadays, while the letters of appreciation are still pleasing, they do not satisfy the average employee. It is obvious that sentiment does not rank so high in the work shop as it used to do.

Of course, there are reasons for these changes and probably one of them is that there are now so many and diversified outside attractions that compete with work in drawing interest. We have ample evidence that the outside attractions are taking care of themselves, in some cases to the disadvantage of the employees' work. Therefore it behooves all who are interested in an increase of production to find the means of securing some of the employees' interest that is due his work.

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Two Methods of Making Flywheels

By Fred H. Colvin
Editor, *American Machinist*

Fixtures and methods used in making both the Hupp and Stutz flywheels—Machines used in turning, drilling and balancing wheels

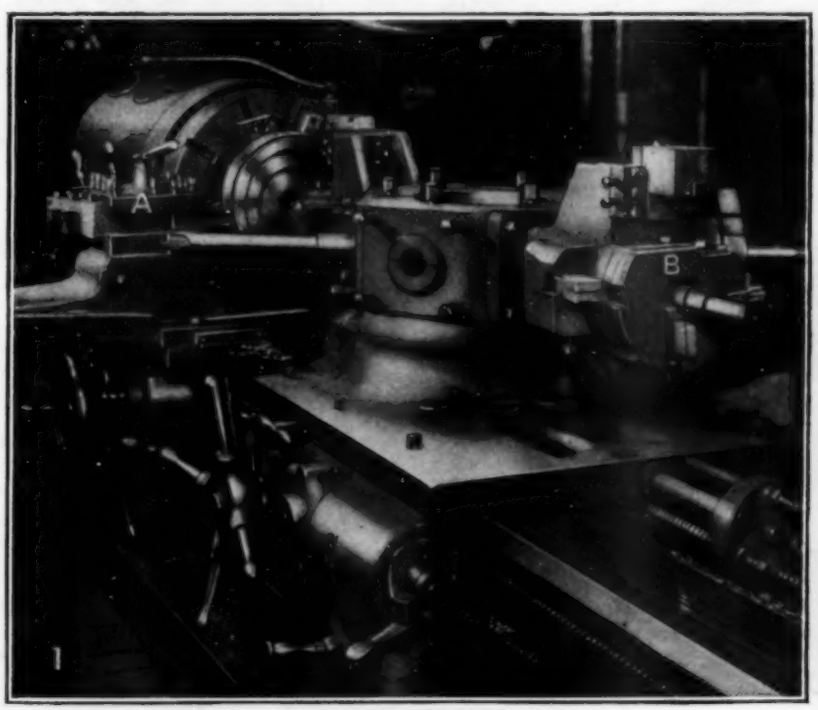
THERE are three types of machines used in turning and boring the flywheel for the new Stutz engine. The first operation is performed on a Libby lathe, as in Fig. 1, which also shows the tooling of both the turret and the cross-slide. The toolblock *A* carries 3 tools. The tools in the boring head *B* finish the inside of the flywheel as it is shown in the chuck. The roughing tool is in position in front of the work.

After reaming, the pilot in the head *B* steadies the head for the broad, finishing cuts. Two holes are then drilled in the face of the flywheel for locating in future operations.

From the Libby lathe, the flywheel goes to the Bullard vertical lathe, Fig. 2, where the other side is faced and the rim turned. Following this operation, it goes to the Gisholt lathe in Fig. 3. The flywheel is held in a special chuck that is bolted to the faceplate. The wheel itself is held by the three straps shown, so firmly that the broad surfacing cuts can be taken without chatter, leaving a smooth, finished job.

The holes for all clutch attachments and for bolting to the crankshaft flange, are then drilled in the Baush multiple machine, Fig. 4. The drills are guided by the bushings in the swinging plate shown, the plate being located by bolts in the holes at *A* and *B*. The fixture is simple and easily handled.

In Fig. 5, the wheel with the steel starter-gear in place, is shown mounted on a standard shaft for bal-



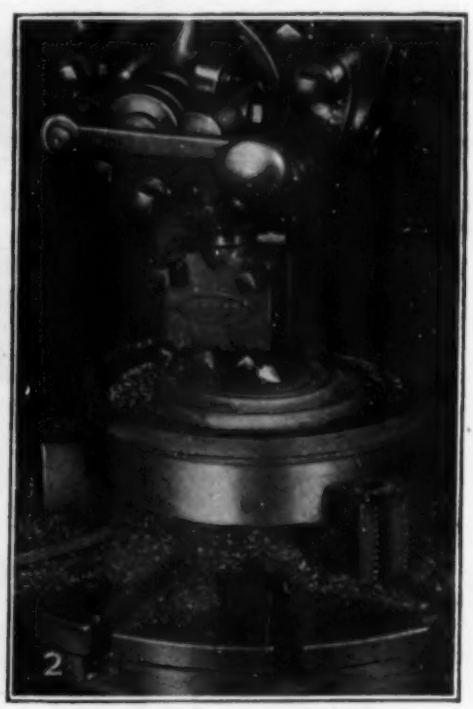


Fig. 1—Rough turning the flywheel. Fig. 2—The second operation

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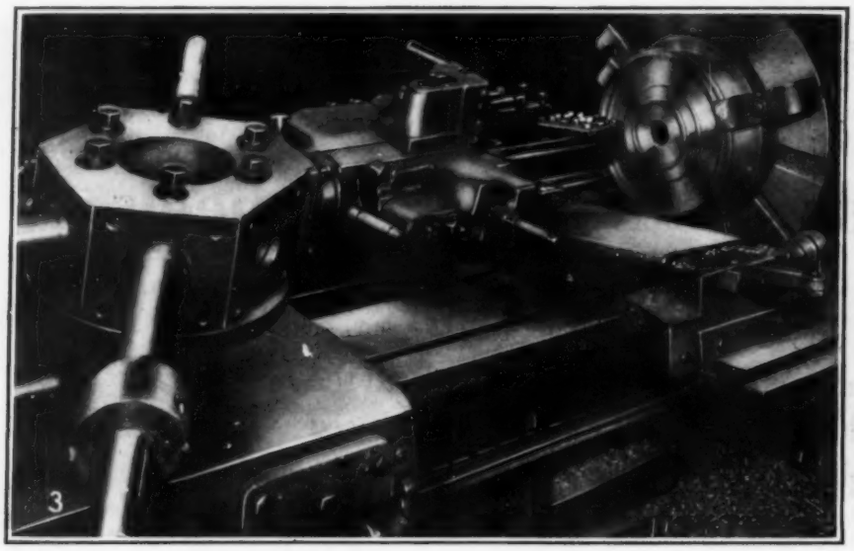

Fig. 3—Finishing the Stutz flywheel.

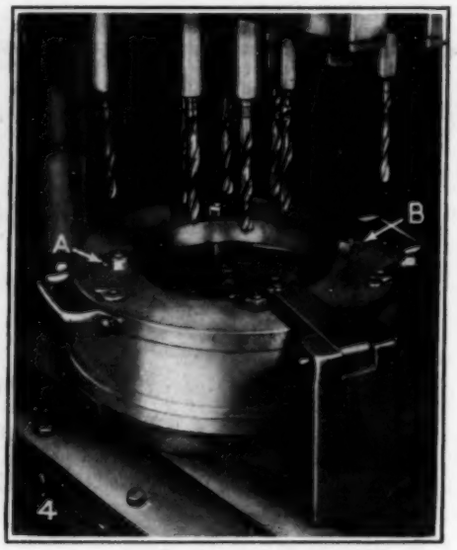

Fig. 4—Drilling fixture for all holes

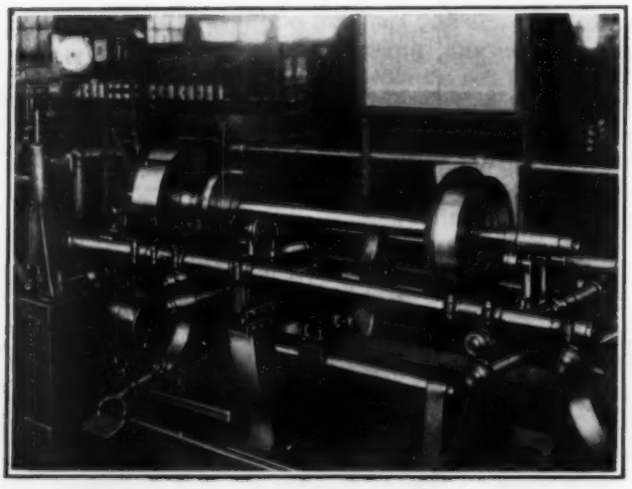

Fig. 5—Balancing the finished flywheel

ancing in the Precision balancing machine. The crankshaft is also balanced, so that when it and the wheel are assembled, there will be no trouble from vibration.

The Hupp flywheel is typical of many similar jobs, with, of course, the slight variations found in nearly all engine designs. The wheel is rough bored, faced and turned on a Gisholt Simpli-matic, as shown in Fig. 6. The facing cut is broken up by several tools held in substantial toolblocks that hold them to their work.

The turning of the other side is also done on a Simplimatic, as in Fig. 7. Here the flywheel is reversed and held in a special chuck. The boring bar and boring tools are clearly shown. With the short overhang of the chuck, heavy cuts can be taken with but little spring to the work, even under heavy cuts.

Conveyors carry the flywheels to the drilling and tapping machines shown in Fig. 8, the line beginning at the left and coming past the machines to the tapping head at the right. The multiple-spindle machine drills the

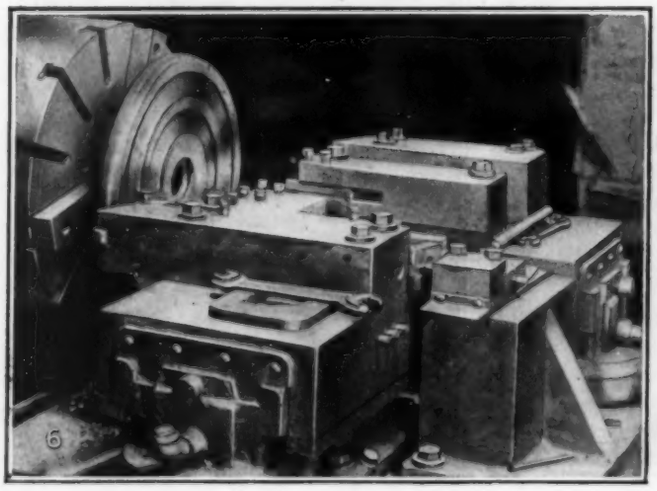

Fig. 6—Roughing on a Simpli-matic.

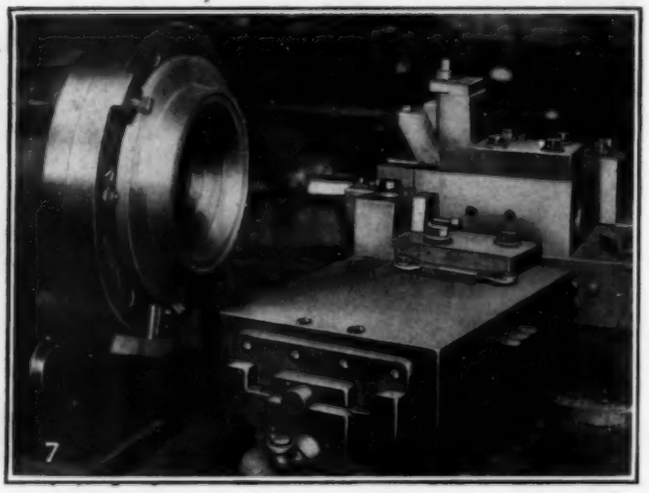

Fig. 7—Finishing the Hupp flywheel

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Fig. 8—Drilling and tapping

holes in the face of the flywheel, utilizing the jig *A* to guide the drills. The next machine performs an angular drilling operation, the drill bushing being carried by the arm *B*, which reaches inside the wheel. The arm is hinged and can be swung out of the way for loading.

In the next machine in the line is an indexing fixture for drilling various holes around the rim, while in the last machine four of the holes drilled in the first machine are tapped. The teeth for the starter gear are cut on a Fellows, high-speed gear shaper.

A study of the tools in the toolblock *A*, Fig. 1, and of those in the toolhead *B* in the same figure, will show how well they are supported. The head *B* is bolted against the face of the turret and so secures rigid support. Then, too, the mass of cast iron in the head absorbs vibrations and makes for steadier cutting and smoother surfaces.

The tools with narrow cutting faces that break up the scale on the surface of the casting are not shown in detail, but the result of their work can be seen on the flywheel in Fig. 6. For, although the lathe is of an entirely different type from the ordinary, the tool action is the same. The toolblocks in Fig. 6 can be set to suit any desired condition.

A somewhat different arrangement obtains in Fig. 7, which, though in a similar machine, has a different toolblock combination. Both of these operations contain suggestions that can be used in other than automobile shops, and on work where the quantity is not necessarily confined to large lots.

No new machine should go into a shop until the men responsible for production are more or less familiar with its new features and are interested in its success. Every man should be interested in making it do what is intended for the sake of his production costs, whether he likes the machine or its builder. Many machines have failed that could have been money makers for the users, if there had been co-operation instead of opposition in the shop where they were tried.

Holding Chain Drives at Constant Tension

By F. W. Curtis

THE behavior of its silent chains for automotive purposes was improved by the use of an automatic idler and vibration damper, developed by the Link-Belt Company. This device recently has been applied to chain drives for machine tools.

The feature of the automatic adjustment is that it not only takes care of any elongation that develops in the chain in service, but also insures longer chain life

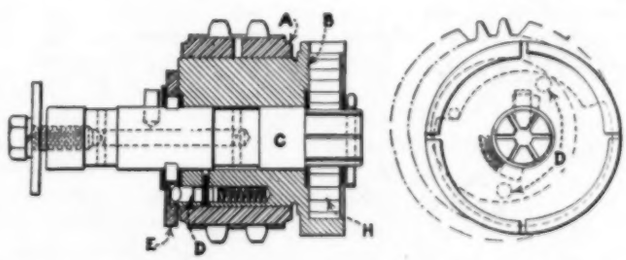

Fig. 1—Details of automatic idler and vibration damper

and sustained quiet operation. Automatic adjustment saves the chain from the high-inertia strains that are liable to be set up when lost motion between shafts exists. Automatic adjustment also exerts considerable influence as a vibration damper. The device shown in Fig. 1 consists of the idler sprocket *A*, mounted on the eccentric bushing *B* so that it can revolve freely. The bushing, in turn, is mounted on the stationary shaft *C* and is under control of the coiled spring *H*.

As the chain becomes slack, the spring *H* causes the eccentric bushing *B* to partially revolve, causing the idler sprocket to move in a direction that will take up the slack. Two spring-actuated plunger pieces *D*,

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acting as pawls, are in constant engagement with the ratchet plate *E*, so that when the eccentric bushing has revolved a distance equal to the pitch of the ratchet, the bushing is held against any backward movement. As further slackness occurs in the chain, the operation is repeated, thus automatically maintaining the chain in proper tension.

Chain drives with an automatic idler can be applied to all styles of metal-working machines in which the driving power is between ¼ and 25 hp. In rare cases this maximum capacity can be exceeded, however. Some of the methods of application are shown diagrammatically in Fig. 2. A straight, vertical chain drive, as at *A*, is used on some machines, but this arrangement has no provision for keeping the chain in proper tension and contact, except by taking out one link after enough wear has occurred to require its removal. The same drive equipped with an automatic idler is shown at *B*, in which case the proper tension is maintained throughout the life of the chain. In this case, the idler is enclosed within the path of the chain drive, as will be noted. By using the back-type chain, that enables meshing from either side, the idler sprocket can be positioned outside the path of the chain, as shown at *C*. A countershaft drive can be installed, such as shown

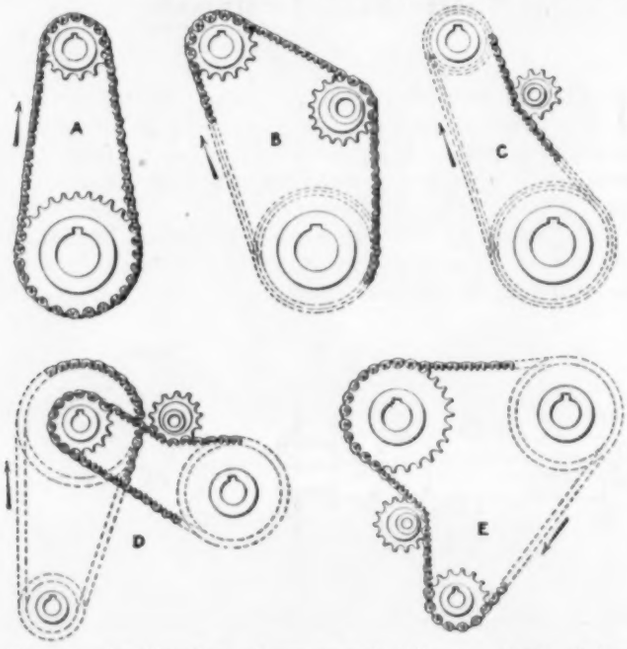


Fig. 2—Application of automatic idler to chain drives

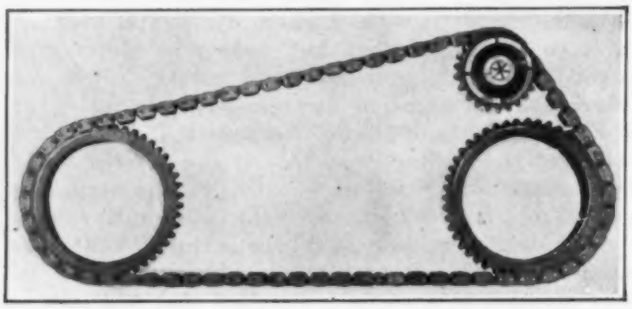


Fig. 3—Method of mounting automatic idler

Fig. 4—Machine equipped with idler and back-type chain

at *D*, and a double-spindle drive as at *E*. The last two examples require back-type chains, but can be arranged to operate with plain chains by placing the idler on the inside instead of the outside.

In applying the automatic idler there are no changes required in the location of the driving and driven units. It is necessary only to provide a stub shaft for the idler to suit the style of drive to be adopted, such as shown in Fig. 3. However, it is good practice to encase the drive so it will operate in a bath of oil. Since the average application of a chain drive provides a contact over a large portion of the sprockets with which it meshes, sometimes being more than half the circumference, a durable drive is produced. Then, if the chain can be held at a constant tension, a still smoother drive will result.

Microphotographs of work, ground on a machine on which both a plain chain drive and a drive in which the tension was automatically maintained were used, showed that the finish produced by the latter type of drive was considerably the better. In Fig. 4 is illustrated a drive in which the tension of the chain is automatically controlled. In this example, the smaller sprocket in the bight of the chain is the driver, and the larger sprocket on the spindle is the driven unit.

When the speed ratio is to be changed, it does not affect the idler. The correct wheels are installed and the chain is lengthened or shortened as the case may be. In putting the chain on, it is necessary to turn the bushing with its idler sprocket enough to allow sufficient slack or play in the chain. Then, as the machine is started, the idler will adjust itself automatically to the proper chain tension.

Examples of Press Tool Design for Typewriter Parts

By W. E. Irish
Associate Editor, *American Machinist*

Description of tools with diagrammatic layouts to indicate their construction and action—An illustration of the possibilities in finger-die design—A channel-rolling machine

TYPEWRITER design lends itself particularly well to the application of press work, and as a result the press department forms an important part of the production division. The work is small, with accuracy a paramount requirement. These points, coupled with quantity runs, determine the tool design and the press application to a large extent.

The press room at the L. C. Smith Brothers Typewriter Co. in Syracuse, N. Y., contains two main rows of quick-acting punch presses, a number of larger machines for the heavier blanking and squeezing operations and several special machines for spinning, countersinking, rivet setting and rolling.

Girls are employed for the light work, requiring high-speed production, while men handle the raw strip and sheet material from which the first operation blanks are cut. Roll feeds are used to advantage on these blanking operations to carry the strip stock between the tools. In Fig. 1 is shown one of the blanking set-ups.

Another of the parts run in a roll-feed press is the key cup, the tool for which is illustrated in Fig. 2 and indicated in cross-section in Fig. 3. The part measures approximately ½ in. in diameter and has a flange standing about ⅛ in. in height. In the center of the web there is a rectangular hole, in which the key lever is inserted later.

The tool performs the operations of blanking, forming and perforating the rectangular hole simultaneously as rolls feed the cold-rolled strip through the press.

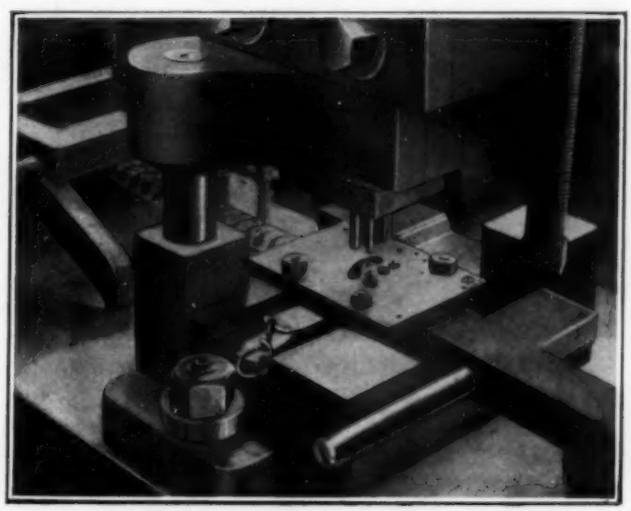


Fig. 1—A roll-feed setup for blanking work

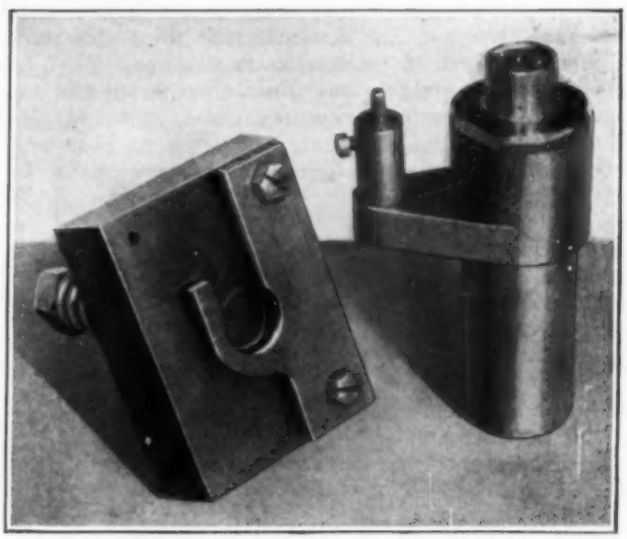


Fig. 2—A cup blanking, forming, and piercing tool

The small pin shown to the left of the main punch in Fig. 2 is simply a guide to register in the open hole in the die block for aligning the two while they are being set. It is not indicated in Fig. 3. In the cross-section, part *A* acts as the blanking punch on its outer edge and as the forming die on the inner side. The perforating punch *B* is centrally located inside *A* and blanks the center hole down through the central portion of the main die block *A*. This die block carries the shearing edge for the main blank, is recessed for the stripper ring *D*, and constitutes the forming punch in its central portion. Another stripper plate *E* serves to strip the punch *B* and to bring the part out of the punch as the press ram moves upward, and two auxiliary stripper pins *F*, which are proportioned to ordinarily project a little below the lower face of *E*, forestall any chance of the part sticking to the stripper due to excess lubrication. No means is shown in the cross-section for limiting the stroke of the stripper plate *E*. There are, however, two pins for this purpose with heads terminating inside of the main punch which are located at right angles to the section taken for illustration of the main tool.

One of the typewriter parts, a link, had to be blanked and perforated, and then formed to a U-shape, so that

pairs of holes in the end would match exactly. It was, therefore, necessary that the forming tool action should have no tendency toward drawing the material. The part and a cross-section indication of the tool construction are shown in Fig. 4 and in Fig. 5, the latter being a view of the tool in position in one of the small production presses.

In Fig. 4, the half of the section to the left shows the tools in the up position, while that to the right indicates the punch at the bottom of its stroke. The downward movement of the press brings the punch *A* to contact with the work registered between its gage pieces *B*. Continuous movement bends the work into the opening between the rotating die parts *C*, and, as the punch follows to the bottom of the stroke, these die parts rotate in their bearings in the die block *D* and close the work into its finished shape without putting any action of drawing into the movement.

Four steps in the manufacture of the ribbon spool base are shown in Fig. 6, starting at the bottom with the part ready to form into its final shape. The next operation to the right, above, contains no unusual features and is done in an ordinary U-die.

The second operation from the left, which consists of closing the part into a circle, is done in the tool shown in Fig. 7. The parts, previously formed to the U-shape, are slid under the center floating pin and the U-shaped punch closes the work in to form the complete circle. While the pin is held to position in the die by means of a vertical screw pin, and is limited as to side motion by means of a pair of horizontal setscrews, it has freedom of movement to an extent that allows it to exactly center under the punch and to not bind the work as it is formed. In order not to affect the shape of the pointer at one end of the piece, there is a depression cut for clearance in the punch block.

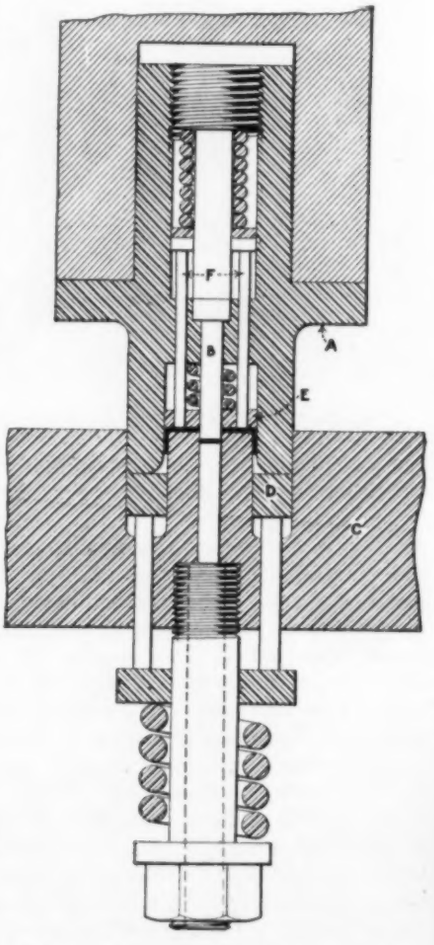


Fig. 3—Cross-section diagram of the cup tool

In order to finish the piece, as shown to the left, above, in Fig. 6, it is necessary to fold the two projecting ears, one over the other, and to perforate the hole at the center through them both. These operations are performed in the finger tool illustrated in Figs. 8, 9 and 10, showing the punch and two views of the die respectively.

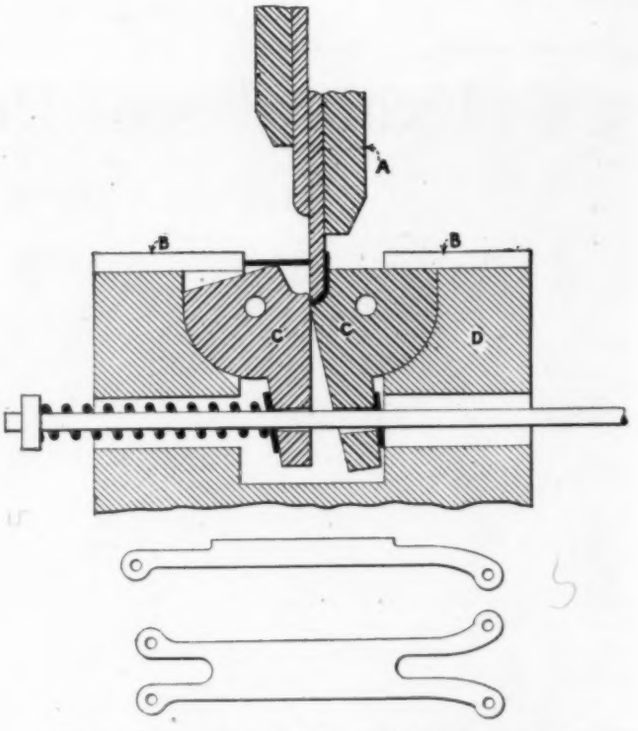


Fig. 4—Diagrammatic layout of a folding tool

The die contains a slide on which a pin for carrying the work is mounted. This slide is pulled out to remove a finished part and to load a new one into position as shown in Fig. 10. As soon as the new part is located, it is pushed into working position and the press is tripped to perform the operations of folding and perforating simultaneously. In Fig. 10 is shown the position of the work and the die parts closed in as at the bottom of the press stroke.

The action can be understood by reference to the indicated cross-section of the tool shown in Fig. 11. To the left, the tool is shown with the punch at the top of its stroke and to the right at the bottom of the ram travel. In the section to the right and above is shown a side section of the punch.

Upon making a hit, the guide pin *A* registers with a hole in the work slide *B* to locate the work exactly.

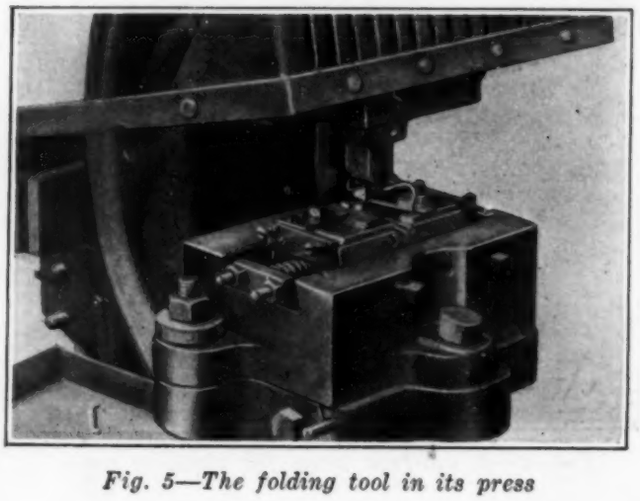


Fig. 5—The folding tool in its press

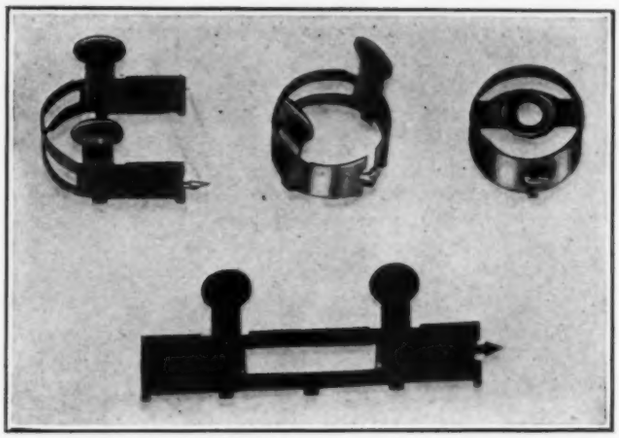


Fig. 6—Four steps in making a ribbon spool base

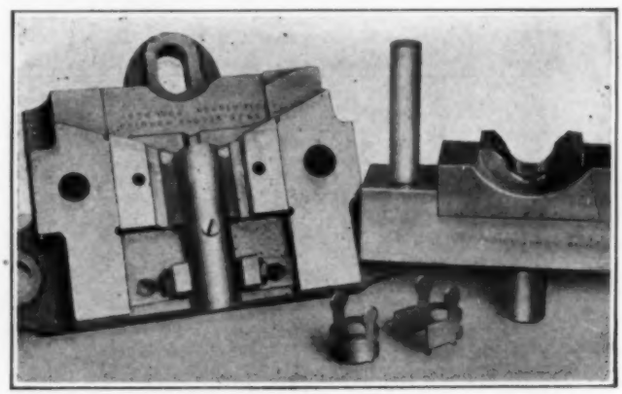


Fig. 7—A forming tool with a floating mandrel

The two spring pins *C* register against the edge of the work to hold it down. As the downward movement of the punch continues, the two inner punch fingers *D* act to close the lower slides *E* against the work to hold it laterally and to prevent distortion. Almost simultaneously, the outer fingers *F* force the upper slides *G* against the projecting ears on the work and hold them down. The active portion of the finger *F*, to the left, actuates its slide enough ahead of the one to the right, so that the ear on the left-hand side starts to fold first and finishes under the other ear. The slides *G* continue to advance until they overlap the work and just clear the central punch *H* as the final portion of the ram movement forces it through the material of the ears to perforate the center hole. The blanks are forced down through the work-locating pin *J*, which acts as the die, and out through the slide and bottom die block.

In Fig. 12 is shown a tool for making an odd shaped part. The cup forms approximately three-quarters of a complete circle, the remaining open portion extending outwards in line with the cup bottom to terminate in a perforated ear. One of the finished parts and one of the blanks are shown laying on the front of the tool. In order that the bottom of the cup remain in alignment with the extension, the punch carries a corresponding extension. It was not found necessary, however, to extend the spring stripper under this portion, the circular part shown in the die being sufficient to return the work as the punch lifted out.

Two dies for forming a small hinge are shown in Figs. 13 and 14, the first and final operations respectively. In Fig. 13, one of the finished parts is shown with the hinges completed on both of its ends, and in Fig. 15 is an end-view indication of the first operation tool.

Referring to the illustration of this tool, Fig. 13, the hand lever to the left is depressed to draw the slide back. This movement creates a space between the raised ears on the slide and the ends of two pins secured in the bending arms and allows the straight projections on the work to be entered below them. The end

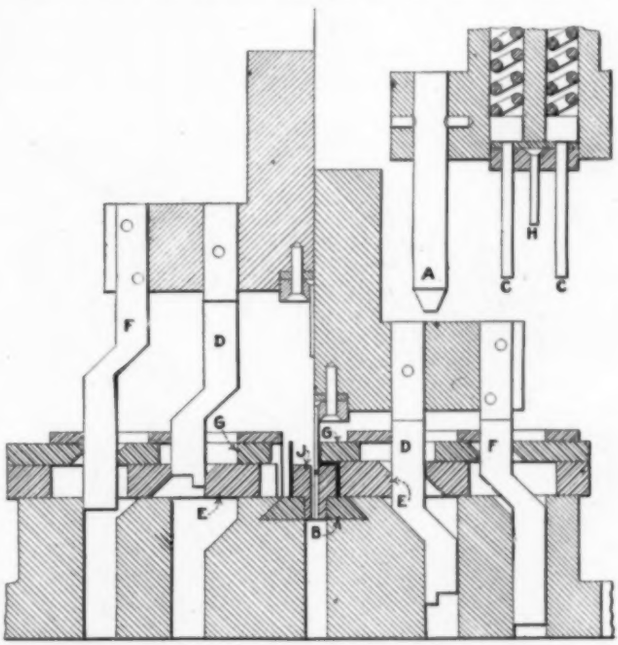
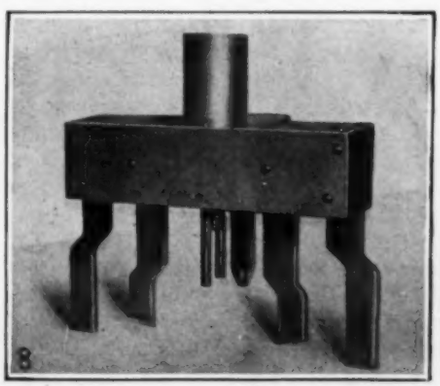
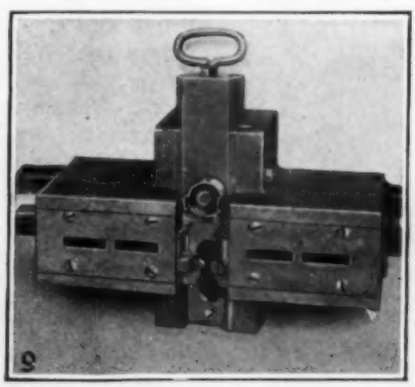


Fig. 11—Cross-section diagram of the finger-tool





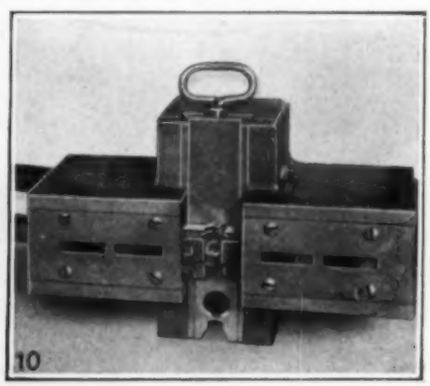


Fig. 8—The finger-tool punch. Fig. 9—The die in the loading position
Fig. 10—The finger-tool die within the closed position

of the work registers in a slot in the body of the die and the piece centers on the slide. The hand lever is then released and the slide moves forward until the pins enter the raised ears and are supported by them as well as in the bending arm. The punch for this tool consists only of a block which acts to depress the toothed ram in the body of the die.

Referring to Fig. 15, the pins are indicated at *A*, the bending arms at *B*, the toothed ram at *C* and the work at *D*. The spindles, of which the arms *B* are solid extensions, are machined with teeth to mesh with those on the ram so, when the latter is depressed, the spindles are rotated. To the left, the tool is shown after the work has been placed, and to the right the position of the bending arm and the shape of the work is shown as at the bottom of the press stroke.

The hinges are closed in and are finally shaped in the tool shown in Fig. 14 by drawing back the slide toward the right to expose the ends of the two mandrel pins, inserting the work from the left and drawing it back over the pins, returning the slide to push the work to position and again support the pin ends, and tripping the press to bring down the closing punch shown in the illustration.

Accuracy is of utmost importance to typewriter manufacture, with the result that a number of the parts are put through shaving operations after they have been otherwise completed. One of these operations is shown in Fig. 16 on the part shown in Fig. 17 below.

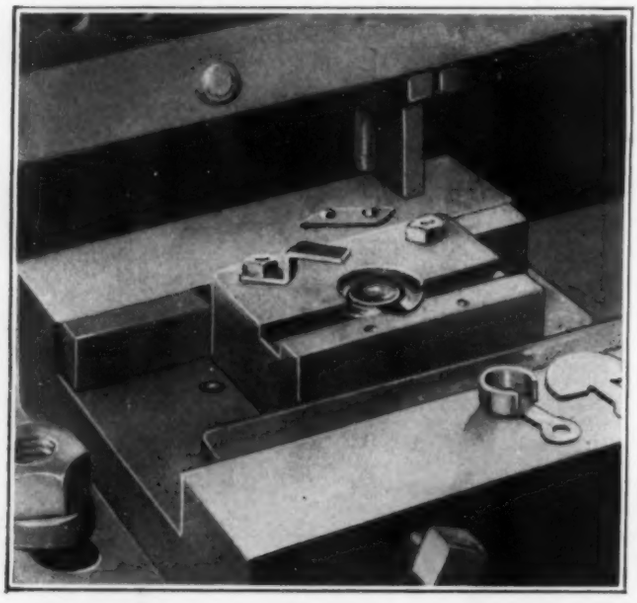


Fig. 12—A tool in place to form a partial cup

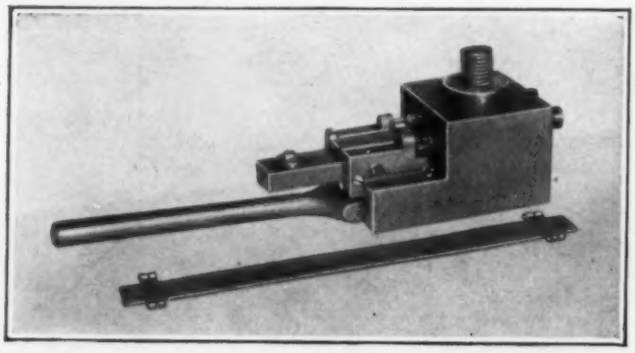


Fig. 13—A first-operation hinge-forming tool

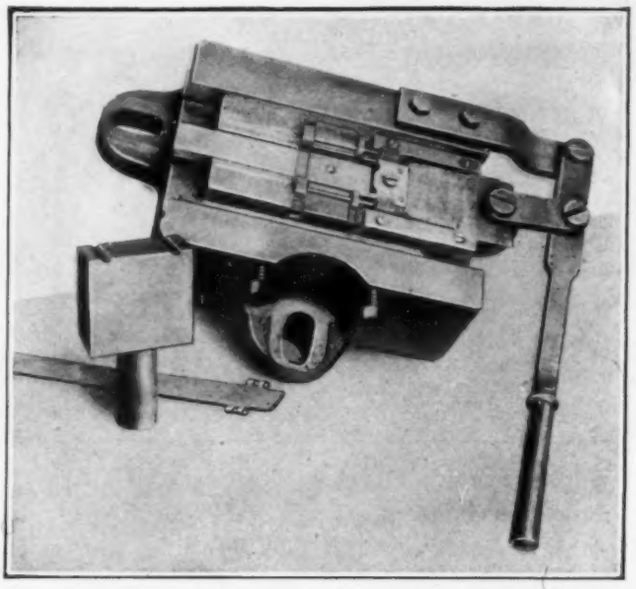


Fig. 14—The second-operation punch and die

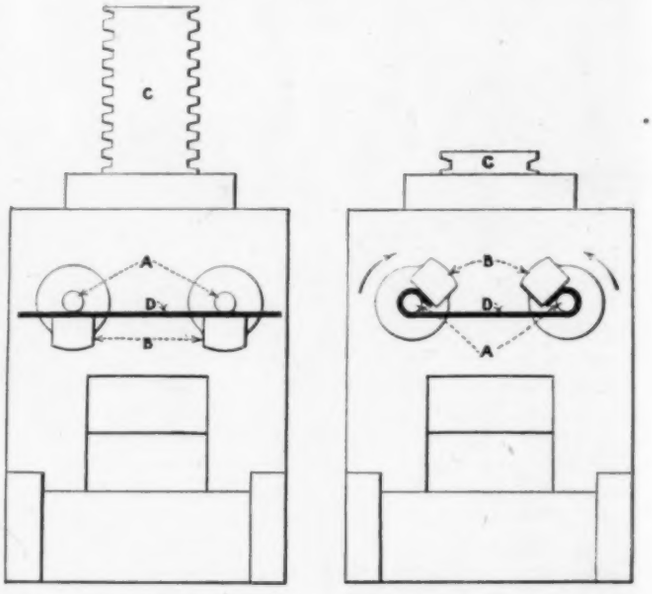


Fig. 15—End view indication of the tool pictured in Fig. 13

In this operation the hole in the circular end and the notch at the opposite end are shaved in accurate relation to each other. The work is located over the pin *A* and side guides on the die block. The punch *B* enters the block first to back itself up for the notch cutting and then it and the shaving punch *C* enter the work. On the return stroke, the work is carried up by the punches while the chip from the punch *C* is left behind in the die until the locating pin *A* raises it to the surface of the die block. This chip is then gotten rid of by, at the right instant, admitting a puff of air through the orifice *D*.

The work continues upward on the punches and compresses the spring behind the ejecting pin *E* as it rises toward the stripper *F*, so that when further travel is limited by the stripper and the punches pull out, the latch acts to shoot the completed part out of the die and into a box at the side of the press.

There are a number of operations on the various

parts made in the press department that have been found to lend themselves more readily to machines other than presses. One of these, picked at random, is a semicircular channel piece approximately 12 in. in diameter. The operation is one of rolling flat stock, previously blanked, into the required shape. The machine for doing the work is shown in Fig. 18, with a diagrammatic outline in Fig. 19 to indicate its action.

Referring to Fig. 19, the machine consists of a circular plate *A* driven by power. It is, in thickness, equal to the inside dimension between the flanges of the channel and, in diameter, is approximately equal to the curvature required in the finished piece, being slightly smaller.

There are two slots *B* in this plate into which the end of the work *C* is entered, as indicated in the diagram. On the machine, as shown in Fig. 18, there is a table at this position to assist in entering the work and to serve as a guide as the steel is drawn around the plate. There are three rollers, all adjustable toward or away from the table. They are marked in the diagram *X*, *Y* and *Z* and are indicated in section to the right-hand side.

The first roll *X* is only a guide, the next *Y* bends the flanges as indicated, and the third, *Z*, completes the channel form. All three serve to make the channel conform to the approximate curvature of the plate. The parts can be turned out with surprising rapidity in this machine. Its advance is continuous and the operator's work consists only of entering new stock and removing finished pieces. The long end, which is entered in the slot for feeding purposes, is cut off later.

There are many other tools for many purposes in this busy department. Some are of usual design, others are distinctly unusual. They all combine to convey a decided impression of the length to which the company has gone to obtain accuracy on each detail of each part that enters into the final assembly.

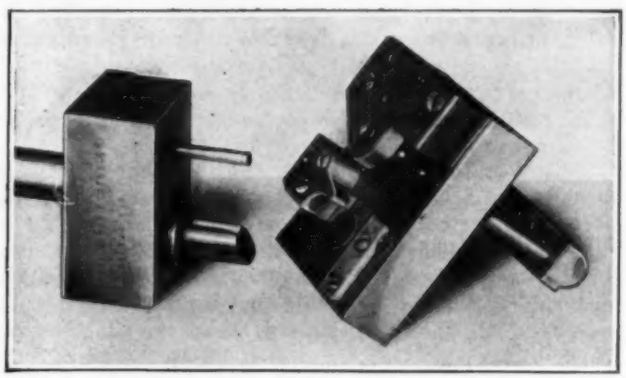


Fig. 16—A shaving tool

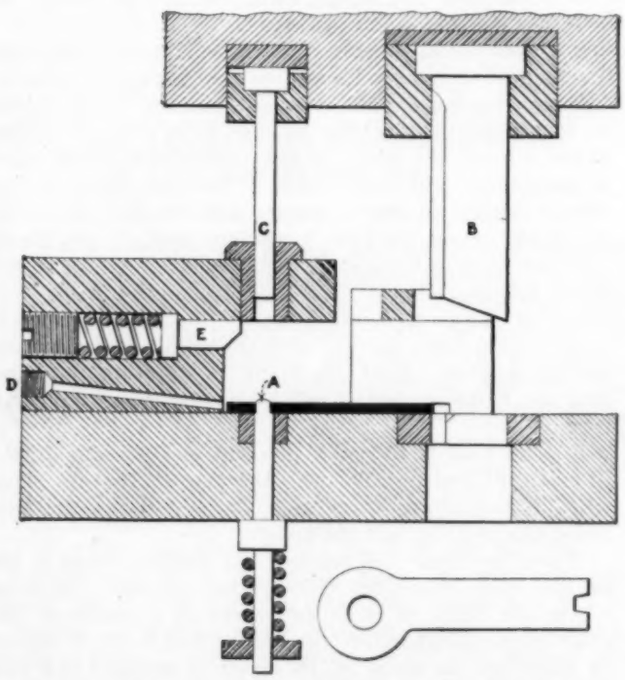


Fig. 17—Cross-section diagram of the shaving tool

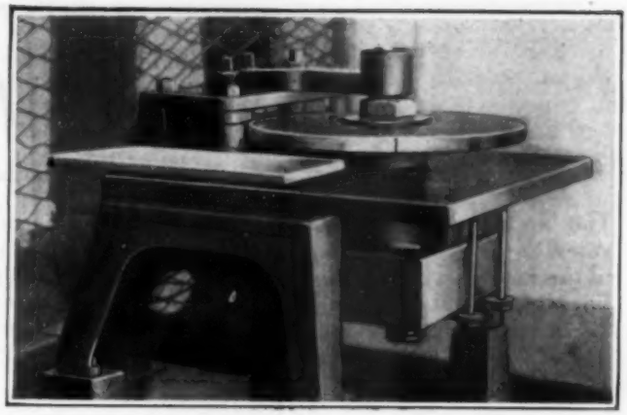


Fig. 18—A channel rolling machine

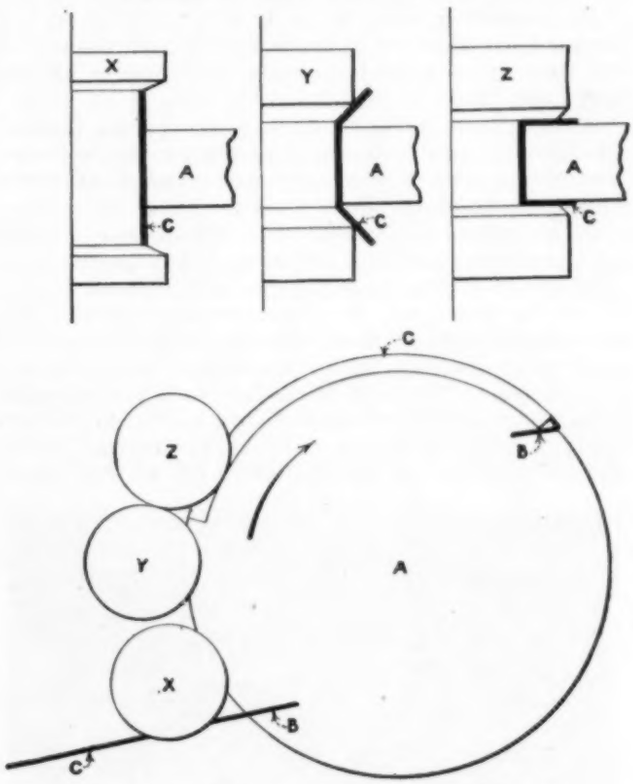


Fig. 19—Diagram of the rolling machine

When the railroads start to complain about the competition of automobiles they should remember that the General Motors Corporation alone used 380,700 freight cars in 1925 and paid freight bills of $57,000,000.

Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Safety Appliances

BY B. S. HAVENS

In re-spooling wire, there is always more or less danger from accidents to the workman from the end of the wire flying around the room, as it comes off the first spool.

At the York Insulated Wire Works of the General Electric Co., two methods of protecting the workmen from flying ends of wire have been adopted, as shown by the accompanying illustrations.

When re-spooling heavy wire from spools, located some distance apart, the wire is passed through a pipe, as shown at *A*, Fig. 1. When the end of the wire comes off of the first spool, the pipe prevents it from flying around the room, tripping or injuring the workmen.

When re-spooling light wire, where the spools are close together, the girls doing the work are protected by a heavy plate of glass, as shown in Fig. 2. Should the wire break during the operation, the ends will strike the glass, and when the end comes off the first spool, the same protection is afforded the operator. The glass is hinged so that it can be turned back so as to be out of the way when spools are to be changed. When it is in place, as shown in the illustration, the operator has an unobstructed view of the work.

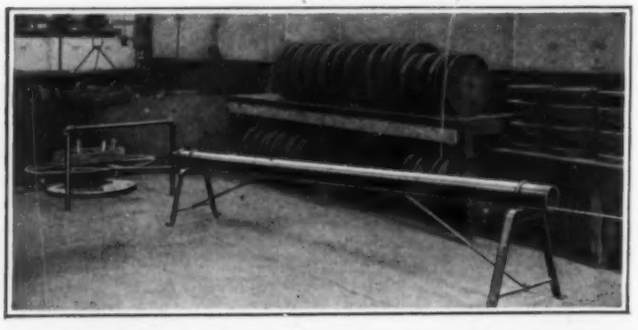


Fig. 1—Protection by an iron pipe

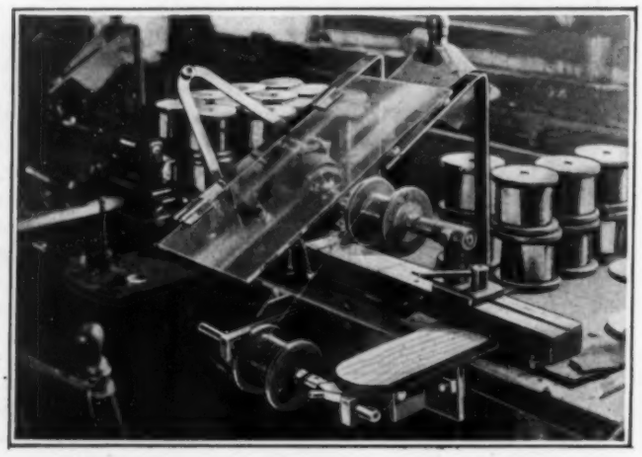


Fig. 2—Protection by a glass plate

Bluing the Faces of Blanking Dies

BY CHARLES DOESCHER

The face of a blanking die that has been blued by heating preparatory to laying out, always makes the ideal, in that the scribed lines are so easily seen against the dark-blue background, and for this reason are much more easy to work to, particularly so when using artificial light, than are lines scribed on a surface coated with blue vitriol.

Before bluing the die blank, the face should be made smooth and free from scratches in order to allow the scriber to scribe straight, even lines. Care should be taken after polishing to keep the surface clean and free from finger prints, for a finger-marked surface will be unevenly colored and spotted and unfit for laying out purposes. It therefore pays to wrap the die blank in paper to keep it clean, in case it has to be sent to the blacksmith shop or the hardening room to be blued.

If the die blank is fairly large, it can best be blued over a hot plate, and should be moved around from time to time to insure even heating.

It is surprising how easily and quickly one can blue the face of a small or average size die blank over an ordinary bunsen burner. To do this, the blank should be laid face up over the handles of a pair of tongs, which in turn are laid over the supporting fixture used in connection with the burner. The blue flame of the burner coming in direct contact with the bottom of the die blank, causes the heat to radiate through the blank.

A few helpful suggestions that could be added to the above are as follows: Use a medium-sized flame—too strong a flame or, in other words, too much heat, will draw the color too quickly with the result that the color will be uneven. Hold the blank in different positions over the flame so that it will be heated evenly and uniformly.

A good plan is to use a piece of clean waste dipped in clean oil and lightly swab the face of the die blank when it begins to warm up. The oil cleans the face and helps to bring out the colors.

When the blank has reached the desired color, it can be laid on a bench-block or die-bed to cool. In cases where the blank is large and there is a chance of the color running out before the blank cools down, it should be quenched in clean oil in order to prevent the face from becoming spotted.

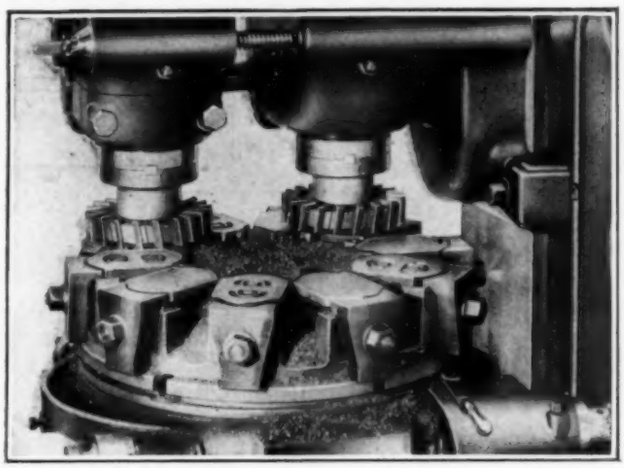
Finishing Opposite Sides of Valve Plates by Continuous Rotary Milling

By G. L. Erwin, Jr.

The rotary fixture shown in the illustration was designed for rough and finish milling cast-iron valve plates for ice machines, on both sides in two passes, the production being continuous.

The fixture holds ten pieces, and there is a difference of $\frac{1}{16}$ in. in the height of alternate stations.

The pieces are inserted in the "low" stations and pass under both cutters, one of which is set for roughing, while the other one is set for the finishing cut. As fast as the pieces come from under the finishing cutter, they



Roughing and finishing by continuous milling

are removed, turned over and transferred to the "high" stations, and again pass under both cutters. Thus, both sides are roughed and finished without stopping the machine or resetting the cutters.

The fixture is mounted on a No. 3B, Milwaukee universal milling machine, equipped with a rotary table and a two-spindle vertical attachment.

The feed is 11 in. per min., and the speed of the cutters is 40 r.p.m. The material is gray iron, annealed at 1,300 deg. F., and the production is 140 to 145 pieces per hr., roughed and finished on both sides.

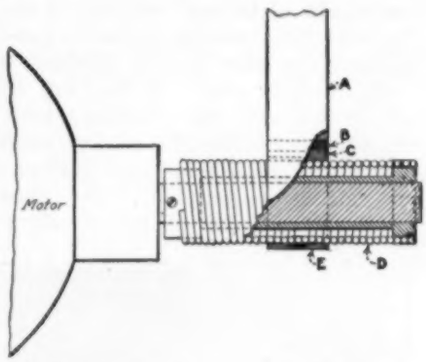
An Efficient Friction Drive for Small Motors

By Dexter W. Allis

When a mechanical device is to be driven by an electric motor of small size, it is common practice to use a worm and wormwheel or a friction roll of some kind to transmit the power from motor to machine. In designing a mechanism of this kind I was called upon to devise a means of transmission that should be simple, silent in operation, durable in construction, and to operate with the least possible loss of power. After all ordinary forms of transmission had been tried and found wanting the following scheme was adopted.

A flat-faced friction wheel *A*, 6 in. in diameter by $\frac{3}{4}$ in. face, was fitted to the shaft of the machine. A rubber band *B*, $\frac{1}{16}$ in. in thickness, was then stretched over the periphery of the wheel and fastened to it with shellac. Over this rubber band was placed a covering of side leather *C*, smooth surface out. The leather was cut from the skin in the form of a ring and stretched while wet, into collar form. Shellac was used to cement the leather to the rubber.

The $\frac{1}{4}$-in. diameter motor shaft was fitted with a sleeve having a $\frac{1}{16}$-in. diameter flange at each end. Over this spool-like member was slipped a close-wound coil spring of No. 20-B & S gage piano wire, as at *D*, which was soldered at its ends to the flanges. The spring was so wound that the turns were not under tension, one against the other. Surrounding the spring at a point midway of its length was a thin brass sleeve *E*, $\frac{3}{4}$ in. long, held in place by means of solder applied through two small diametrically opposite holes. This spring-supported sleeve formed a friction roll that was perfectly yielding to—and from—the shaft of the motor. The sleeve was run with slight contact-pressure against the leather rim of the wheel, after the leather had been treated with a thin leather-preservative of the kind used for waterproofing shoes.



Friction drive for small mechanisms

Under exhaustive tests, this device ran without noise, wear or appreciable loss of power in transmitting energy from motor to machine.

Convenient Location of a Factory Office

By Milton Wright

The assembling shop of the Morgan Construction Co. in Worcester, Mass., is a modern building of brick and steel construction, amply lighted by windows in the side walls and from monitors in the roof. It is divided into two separate departments by a wall, built of hollow tile, that extends down the middle of the floor. The division

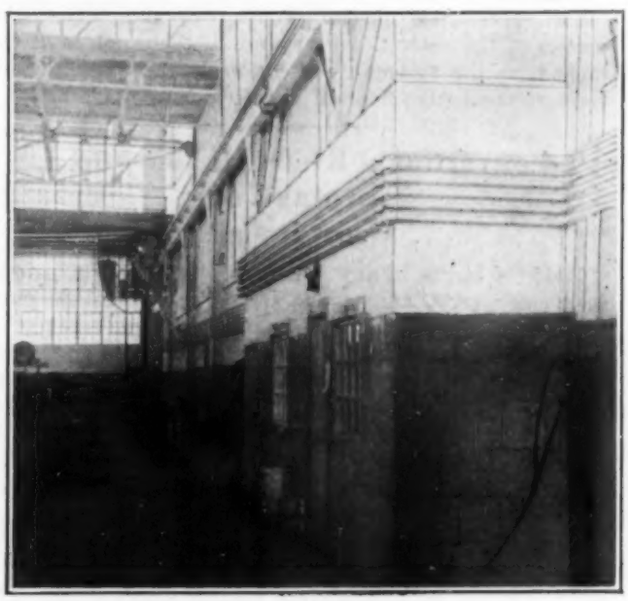


Fig. 1—An office in a shop wall

wall, which reaches to the roof, is shown in Fig. 1 as it appears from the shop floor. Fig. 2 shows a part of the interior of the office.

The factory executives, whose work demands space for desks, filing cabinets and other office paraphernalia, are, by the unique location of the office, placed right "in the middle of things," yet out of the way of the activities of the erecting floors. Space was provided by building the office into the dividing wall as here shown.

An opening about 10 ft. high and 25 ft. long was left in the wall, and extending both ways from it, the office was built about 5 ft. into each department. The picture can, of course, show but one side of the wall, or one-half of the outside of the office. The appearance on the other side of the dividing wall is identical.

Fig. 2—Interior of the office

Ample daylight illumination was provided for by making the ceiling of the office almost entirely of wired glass, so that light from the monitor roof of the building would be uninterrupted. There are also windows in the side walls, as well as glazed panels in the doors that give ready access to either department.

This advantageous location secures to the office personnel, freedom from interruption or interference by reason of the activities surrounding them, while at the same time the foreman and his assistants have a clear view of the entire floor of both departments.

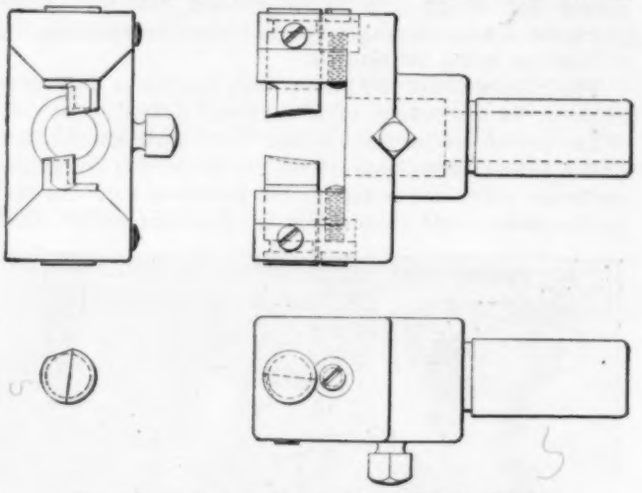
Converting a Knurl Holder into a Turning Tool

By Henry Simon

Half the battle in any job shop is to meet the unforeseen emergency, and at the same time make the most of the equipment at hand. Considerable money is always tied up especially in the turret tools for screw machines, there being many kinds, and several similar ones often being required on a single product, as, for instance, where several diameters must be turned. At the same time, large numbers of tools are idle on the shelves because they are not adapted to the work on hand.

How the functions of a regular B. & S. knurl holder can be expanded to include those of a box tool and balance turning tool, is shown in the illustration. The expense is trifling, and there is no alteration in the tool itself, which can at any moment be reconverted.

The change simply consists in removing the individual knurl holders and replacing them by cutters made from round steel. Since the individual knurl-holder sockets are always made to standard sizes, all that is necessary to make carbon cutters is to cut off



Turning tool made from a knurl holder

pieces of drill rod, form a groove in one end corresponding to that in the knurl roll holder, and shape the other end into a cutting edge somewhat after the manner shown in the drawing. If the cutters must be high-speed steel, they will have to be ground, and they will therefore be more expensive, but even then it will pay to have a set of these cutters on hand, because the converted knurl tool is in some respects superior to the regular box and other turning tools. For one thing, it has an unusually handy and positive fine adjustment. By loosening the clamp screw only partially, thereby leaving a tension on the cutter, it is possible to advance or retract the cutter by small amounts, which are easily controllable through the action of the adjusting screw.

Another advantage is the easily maintained even alignment of the cutters, which is plainly visible at all times, a point in which this tool is particularly superior to the ordinary balance tool. Also, while the converted knurl tool is as rigid as any box tool, it provides better chip clearance, with much less chance for the tool to clog and a better opportunity of watching the work under the cut.

As will be seen from the drawing, it is easy to regrind the cutters without changing their form, and there is considerable to grind off. It is also equally easy to use the tool for right- or left-hand turning, whereas a box or balance tool works one way only.

Selecting Tap Drills—Discussion

By Arthur R. Myers

I would like to add a little more to Mr. Johnson's article under the title given above, on page 681, Vol. 64, of the *American Machinist*. As it is impossible to remember the diameter of all of the A.S.M.E. screw sizes, and not always convenient to have a chart handy, I have found the following method useful: Multiply the number of the screw by the constant 0.013, and add the constant 0.060. The result is the outside diameter in thousands of an inch. Thus, for a No. 10 screw the diameter is 10 x 0.013 plus 0.060, or 0.190 inch.

Gages Used in the United States

Gage No	Washburn & Moen Steel Wire	American or Brown & Sharpe	Birmingham or Stubbs Iron Wire and Sheets	U. S. Standard for Sheet Iron and Steel	Stubbs Steel Wire	Imperial Wire Gage	Morse Twist Drill and Steel Wire	Wood and Machine Screws	Music Wire Gage	Standard Birmingham Sheet and Hoops	Trenton Iron Co.
0000000	.490	.....	.....	.500	.....	.500	.....	.....	.....	.6666	.....
000000	.4625	.....	.....	.469	.....	.464	.....	.....	.....	.6250	.....
00000	.4305	.....	.....	.438	.....	.432	.....	.....	.....	.5883	.450
0000	.3938	.460	.454	.406	.....	.400	.....	.....	.....	.5416	.400
000	.3625	.4096	.425	.375	.....	.372	.....	.032	.....	.5000	.360
00	.3310	.3648	.380	.344	.....	.348	.....	.045	.0085	.4452	.330
0	.3065	.3249	.340	.313	.....	.324	.....	.058	.009	.3964	.305
1	.2830	.2893	.300	.281	.227	.300	.228	.071	.010	.3532	.285
2	.2625	.2576	.284	.266	.219	.276	.221	.084	.011	.3147	.265
3	.2437	.2294	.259	.250	.212	.252	.213	.097	.012	.2804	.245
4	.2253	.2043	.238	.234	.207	.232	.209	.110	.013	.2500	.225
5	.2070	.1819	.220	.219	.204	.212	.2055	.124	.014	.2225	.205
6	.1920	.1620	.203	.203	.201	.192	.2040	.137	.016	.1981	.190
7	.1770	.1443	.180	.177	.199	.176	.2010	.150	.018	.1764	.175
8	.1620	.1285	.165	.172	.197	.160	.1990	.163	.020	.1570	.160
9	.1483	.1144	.148	.156	.194	.144	.1960	.176	.022	.1398	.145
10	.1350	.1019	.134	.141	.191	.128	.1935	.189	.024	.1250	.130
11	.1205	.0907	.120	.125	.188	.116	.1910	.203	.026	.1113	.1175
12	.1055	.0809	.109	.109	.185	.104	.1890	.216	.028	.0991	.1050
13	.0915	.0720	.095	.094	.182	.092	.1850	.229	.030	.0882	.0928
14	.0800	.0641	.083	.078	.180	.080	.1820	.242	.032	.0785	.0800
15	.0720	.0571	.072	.070	.178	.072	.1800	.255	.034	.0699	.0700
16	.0625	.0508	.065	.0625	.175	.064	.1770	.268	.036	.0625	.0610
17	.0540	.0453	.058	.0563	.172	.056	.1730	.282	.038	.0556	.0525
18	.0475	.0403	.049	.0500	.168	.048	.1695	.295	.040	.0495	.0450
19	.0410	.0359	.042	.0438	.164	.040	.1660	.308	.042	.0440	.0400
20	.0348	.0320	.035	.0375	.161	.036	.1610	.321	.044	.0392	.0350
21	.0317	.0285	.032	.0344	.157	.032	.1590	.334	.046	.0349	.0310
22	.0286	.0254	.028	.0313	.155	.028	.1570	.347	.048	.0313	.0280
23	.0258	.0226	.025	.0281	.153	.024	.1540	.360	.051	.0278	.0250
24	.0230	.0201	.022	.0250	.151	.022	.1520	.374	.055	.0248	.0225
25	.0204	.0179	.020	.0219	.148	.020	.1495	.387	.059	.0220	.0200
26	.0181	.0159	.018	.0188	.146	.018	.1470	.400	.063	.0196	.0180
27	.0173	.0142	.016	.0172	.143	.0164	.1440	.413	.067	.0175	.0170
28	.0162	.0126	.014	.0156	.139	.0149	.1403	.426	.071	.0156	.0160
29	.0150	.0113	.013	.0141	.134	.0136	.1360	.439	.074	.0139	.0150
30	.0140	.0100	.012	.0125	.127	.0124	.1285	.453	.078	.0123	.0140
31	.0132	.0089	.010	.0109	.120	.0116	.1200	.466	.082	.0110	.0130
32	.0128	.0079	.009	.0101	.115	.0108	.1150	.479	.086	.0098	.0120
33	.0118	.0071	.008	.0094	.112	.0100	.1130	.492	.090	.0087	.0110
34	.0104	.0063	.007	.0086	.110	.0092	.1110	.505	.094	.0077	.0100
35	.0095	.0056	.005	.0078	.108	.0084	.1100	.518	.098	.0069	.0095
36	.0090	.0050	.004	.0070	.106	.0076	.1065	.532	.102	.0061	.0090
37	.0085	.0044	.....	.0066	.103	.0068	.1040	.545	.106	.0054	.0085
38	.0080	.0040	.....	.0063	.101	.0060	.1015	.558	.112	.0048	.0080
39	.0075	.0035	.....	.....	.099	.0052	.0995	.571	.118	.0043	.0075
40	.0070	.0031	.....	.....	.097	.0048	.0980	.584	.125	.0039	.0070
41	.0066	.....	.....	.....	.095	.0044	.0960	.597	.....	.0034	.....
42	.0062	.....	.....	.....	.092	.0040	.0935	.611	.....	.0031	.....
43	.0050	.....	.....	.....	.088	.0036	.0890	.624	.....	.0027	.....
44	.0058	.....	.....	.....	.085	.0032	.0860	.637	.....	.0024	.....
45	.0055	.....	.....	.....	.081	.0028	.0820	.650	.....	.0022	.....
46	.0052	.....	.....	.....	.079	.0024	.0810	.663	.....	.0019	.....
47	.0050	.....	.....	.....	.077	.0020	.0785	.676	.....	.0017	.....
48	.0048	.....	.....	.....	.075	.0016	.0760	.690	.....	.0015	.....
49	.0046	.....	.....	.....	.072	.0012	.0730	.703	.....	.0013	.....
50	.0044	.....	.....	.....	.069	.0010	.0700	.716	.....	.0012	.....
51	.....	.....	.....	.....	.....	.....	.0670	.....	.....	.....	.....
52	.....	.....	.....	.....	.....	.....	.0635	.....	.....	.....	.....
53	.....	.....	.....	.....	.....	.....	.0595	.....	.....	.....	.....
54	.....	.....	.....	.....	.....	.....	.0550	.....	.....	.....	.....
55	.....	.....	.....	.....	.....	.....	.0520	.....	.....	.....	.....
56	.....	.....	.....	.....	.....	.....	.0465	.....	.....	.....	.....
57	.....	.....	.....	.....	.....	.....	.0430	.....	.....	.....	.....
58	.....	.....	.....	.....	.....	.....	.0420	Morse Gage, Cont.		.....	.....
59	.....	.....	.....	.....	.....	.....	.0410	.....	.....	.....	.....
60	.....	.....	.....	.....	.....	.....	.0400	67..0320	74..0210	.....	.....
61	.....	.....	.....	.....	.....	.....	.0390	68..0310	75..0200	.....	.....
62	.....	.....	.....	.....	.....	.....	.0380	69..0293	76..0180	.....	.....
63	.....	.....	.....	.....	.....	.....	.0370	70..0280	77..0156	.....	.....
64	.....	.....	.....	.....	.....	.....	.0360	71..0260	78..0160	.....	.....
65	.....	.....	.....	.....	.....	.....	.0350	72..0250	79..0145	.....	.....
66	.....	.....	.....	.....	.....	.....	.0330	73..0240	80..0135	.....	.....

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Lining a Large Cylinder

Q. We are boring a hydraulic cylinder for a liner. The cylinder is of cast iron with an outside diameter of 18½ in., and an inside diameter of 16½ in. We have bored this cylinder to two diameters so that the liner, which is 50 in. long and also of cast iron, will slip in half way. The liner measures 16½ in. outside diameter, and 15½ in. inside diameter. What allowance should we give the liner, and what lubricant would be best? We want to use a hydraulic jack for pressing. Will 10-ton pressure be enough?

A. The A.S.M.E. standard formula gives an allowance of 0.008 in. for a medium force fit on a diameter of 16 in. However, if the liner will be held in place by cylinder heads, you can do with much less than this amount with assurance that the liner will not turn.

The calculated force necessary to press in a 16-in. diameter into cast iron with an allowance of 0.008 in. is only 6 tons, so that your 10-ton jack will have ample capacity. For a lubricant use white lead with any good machine oil.

Efficiency Work in the Shop

Q. We are desirous of putting our plant on an up-to-date basis. Having recently contracted with a firm of cost engineers to install an accounting system, we now want to improve shop methods, but do not care to bring in an outside efficiency engineer at this time. Can you recommend a proper method of attack?

A. Your decision to do the preliminaries yourself is especially a wise one, if you have a shop that has grown gradually over a long period. A first-class efficiency engineer would probably have a "walk-away," and be able to suggest changes faster than your force or funds available could take care of them.

A good procedure is to select a capable man from your engineering or drafting force, and set him to work as an investigator. Starting off from operation to operation on your assembly floor, he will get a good bird's-eye view of the requirements, and soon be able to suggest changes in design, betterment of processes, and general improvements. Then he can gradually work from operation to operation through the whole shop.

The investigator should report to an official higher than a chief draftsman, and preferably to the general superintendent, or manager. However, he should not have authority to order changes. He must have ability to get along with the foremen. On the other hand he should not be dominated by the foremen. Avoid requiring from him long reports at stated intervals, and let the suggestions come in as they arise. Have your investigator take some time studies, even though you do not wish to install piece work, because in making the studies he will analyze the operations better.

You should take every opportunity to demonstrate to the foremen and workmen that your investigator is not a spy, or "gum-shoe" man. If you have chosen the right man for the job, you will note how quickly he will develop, and he will probably be able to make suggestions as fast as you are able to handle them.

Manufacturing in the Jobbing Shop

Q. As jobbing machinists we have recently had occasion to make a quantity of 9-in. three-jaw scroll chucks, and would now like to decide whether to attempt to adopt them as a standard line to help keep our facilities fully employed. Can you give us any reliable information bearing upon this question?

A. Your problem brings up a question that frequently arises in the jobbing machine shop; that is, whether or not a class of work which has been done once successfully should be adopted as a standard manufacturing line. The general answer to the question is that all of the factors should be thoroughly considered beforehand. The plants of some of the successful large manufacturers today are outgrowths of jobbing shops, while on the other hand many shops have lost much money in attempts to launch new lines on the market.

In regard to the three-jaw scroll chuck, it seems to us that you would have to offer a full line of sizes, say from 3 in. to at least 18 in., rather than merely a 9-in. chuck. You must also consider that this line of accessories is already competitive, and that there are several companies now specializing in chuck manufacture.

Your chuck must be a commercial article designed with knowledge of the best features of chucks now on the market. After incorporating all of these features into a proven product, your next step is to ascertain if your manufacturing facilities are suitable for production at a price competitive with other chucks, making sufficient allowance for the advertising necessary to put over a new article.

These are the general rules, which may be modified by particular conditions. For example, you may already have a demand for this article, or it may be that you feel that you can develop a local market sufficient to carry the initial burden. Or again, your need for new work may be an important factor. In any case, we advise you to investigate first into the matter of demand, commercial design, production, and sales cost.

Etching Aluminum

Q. Can you recommend to us an etching solution for aluminum? We have been using ferric chloride on bronze, but do not get results on aluminum.

A. Ferric chloride will sometimes do as an etching solution for copper-aluminum alloys, but for the ordinary light aluminum alloys try hydrofluoric acid, or a mixture of hydrofluoric and hydrochloric acids. Experiment a little to obtain the proper proportion of each to give best results on your alloy.

Technical Abstracts

Grinding in Railroad Shops

In the railroad shops especially has grinding been a boon to reducing production costs, not only in the manufacture of new locomotives but on repair work as well. Grinding machines and grinding wheels are used to advantage in finishing such parts as guide bars, piston rods, piston valve rings, links, studs, knuckle pins, and a diversity of other parts. A few years ago the only grinding machine to be found in the railroad shop was the grindstone, or perhaps a solid wheel used for tool grinding. Today in a representative railroad shop will be found special machines for cylindrical, surface and other types of grinding work.

A costly operation in railroad shops consists in reconditioning cylinders, which are worn readily by the action of the comparatively heavy pistons. Portable grinding devices now are being used, which finish these units very economically and rapidly without removing them from the engine. Fred B. Jacobs in *Abrasive Industry*, April, 1926, p. 109.

Solenoid Load Brakes

Crane hoists require braking equipment to prevent excessive speeds in the lowering direction. Before the solenoid load brake was developed, nearly all cranes using alternating-current power were equipped with an automatic mechanical load brake. The latter places an artificial or friction load on the motor so that energy is required from the power supply to lower a light or loaded hook. Since with this type of brake the friction load is applied during the entire lowering operation, considerable wear of the friction parts takes place, and may require to be taken up frequently by adjustments. A solenoid load brake on the other hand is subject to wear only when lowering at low speeds, stopping, or jogging. With this newer device, all high-speed lowering is accomplished by regenerative braking.

The solenoid load brake replaces the automatic mechanical load brake and also takes the place of the solenoid holding brake. Thus it saves weight and space on the crane trolley for it is mounted on the motor and is only slightly larger than a standard solenoid brake.

In foundries and machine shops where creeping speeds and very small movements of the crane hook are necessary, solenoid load brakes furnish a highly appreciated service. Creeping speeds may be obtained on the first hoisting point of the controller by inserting resistance in series with the coil of the connected solenoid. H. H. Vernon in the *General Electric Review*, April, 1926.

Quantity Production

Production economy depends upon the efficiency of the method of manufacture. Different quantities per day often require the use of entirely different methods and equipment to attain the most economical production. Each type of machine and each method is differently zoned, as determined by the number of pieces required per day — within which a particular method will give the highest efficiency.

Four vertical turret lathes produced 90 wheels per 9-hr. day. The production cost per flywheel on this basis was 69.2 cents per wheel. The continuous machine, employing the multiple-spindle method, produced 140 wheels per day at a cost of 23.9 cents per wheel. At 90 wheels per day for both machines, the vertical turret lathe unit cost was 69.2 cents as compared with 31.2 cents for the multiple-spindle method, the continuous machine in that case operating 64 per cent of full time.

Obviously, the production of any quantity not requiring full-time production of the continuous machine, increased the cost per wheel, as the full amount of fixed overhead had to be distributed over a smaller number of pieces. With the vertical turret lathes, the investment for smaller quantities can be reduced one spindle at a time to suit the demand, excessive burden thereby being avoided. But even by this method of economy in the case of vertical turret lathes, it developed that the unit cost for 50 wheels per day is 72.5 cents per wheel as against 43.3 cents by the continuous machine which carries the full investment burden, although it is in operation only 35 per cent of the time.

This example indicates that highly productive machines may be economical to use even though they stand idle part of the time. E. P. Blanchard, Bullard Machine Tool Co., in *Machinery*, March, 1926, p. 535.

Foundry Conveyors

With a foundry floor 400 ft. long and 160 ft. wide the foundry of the Saginaw Products Co., with the use of four power conveyors for handling molds and with other labor saving equipment, has increased its melt to an average of 550 tons a day. A fifth conveyor is being erected and when this is in operation, the plant will have a daily melting capacity of 600 tons and will produce 420 tons of good castings for the production of Chevrolet cylinder blocks. The foundry was built in 1919 and when started had a daily melting capacity of 200 tons and a casting capacity of 120 tons. The increase in production has not necessitated any enlargement of the foundry floor, the difference in capacity represents the saving of floor space through the use of conveyors.

The mold conveyors for cylinder blocks are 197½ ft. long. The pouring zone is along the last 40 ft. of the conveyor and close to the cupolas. At the end of the pouring zone the flasks are discharged onto a semi-circular gravity conveyor having a 10 ft. radius. Seven drag and six cope machines are used for making the cylinder molds. All these move at a speed of 12 ft. per min. and the flasks are set 3 ft. apart on the conveyor, making the molding and pouring speed of the unit four cylinder blocks per minute.

A production of 2,000 Chevrolet blocks in 9 hr. is accomplished with 80 men or from 25 to 26 blocks per man. Each molding machine has three men, two for making the mold and one for finishing. F. L. Prentiss in *The Iron Age*, April 8, p. 977.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

Established 1877

The Interest of Corporations in Basic Research

SO FAR, but few corporations have had the vision to see how closely their future well-being is tied up with fundamental scientific research. Most of them, if they have any interest in research at all, limit it to applied industrial research in an effort to benefit from the few discoveries made by underpaid and ill-equipped scientists in university laboratories. Industrial research is a necessary and profitable activity but its possibilities would soon be exhausted were there no basic research to unearth new physical truths to apply.

Many business men are apt to regard the scientist with something akin to contempt, probably because he has not the acumen to charge what his services are worth. It is well to remember, however, that modern alloy steels, for instance, would be impossible if it had not been for the research work of college professors who discovered the alloying elements.

In view of the approaching exhaustion of some of our raw material sources basic research is becoming a more serious matter for industry in general and for the big corporation, its directors and its stockholders, in particular. The stockholders must be impressed with the need for contributions to support fundamental investigations, contributions that are entirely legitimate for corporations.

Installment Sales

ACCORDING to certain pessimistic gentlemen the financial structure of business is being undermined by installment sales. They opine darkly that the crash is going to be catastrophic when a business depression finally overtakes us.

What are the facts in the case? A study of installment sales recently completed reaches the general conclusion that they are safe on the whole. It is pointed out that the terms granted by the seller must be dependent upon the expected life of the article. The slow deterioration of a piano or a gas range, and their relative independence of style changes, make them better risks than radio sets, for instance. The repossession value is an important factor.

From the banker's point of view installment paper is desirable because it is a greatly diversified risk and because it amortizes rapidly. The report says that the financing of installment buying, like any other financing, must be based on three criteria: the responsibility of the buyer, the use of the funds, and the duration of the loans.

It is evident from the report that the great bulk of installment selling is done in the retail field and that most of the goods so sold are of the consumption type. Apparently there has been a lack of appreciation among makers and users of production goods, such as machinery, of the possibilities of this method of selling. This is all the more remarkable because goods of the production type meet the banker's requirements much more closely than do the automobiles, pianos and household furniture that constitute four-fifths of the installment business. Machine tools, for example, are apt to pay for themselves in anywhere from 27 days to the same number of months, certainly an interesting risk from the banker's angle.

Why Some Small Shops Succeed

WE FREQUENTLY wonder how some small shops continue to do a fair business when we know of larger shops in the same line that are not especially successful. If we look below the surface, however, there is sure to be a reason.

In one case that comes to mind the great difference lies in the design of the machinery built. While there are several sizes and styles, making a total of twenty in this case, the machines are so designed that nearly all of the parts, except the frames or bases, are made in but two sizes. These are built with ample strength for the heaviest duty that will be imposed, and each can be used on several sizes and types of machines.

In this way the production of the parts that go to make up the units of the machines can be carried on in sufficient quantities to secure low costs. At the same time this plan avoids the necessity of tying up a large amount in stock for sizes that may be called for but seldom. This method also permits the assembling of machines for different purposes on short notice.

When you find a small shop that is making money in these days of big production, it is safe to say that the man at the head has ideas that are in advance of the average practice. He is a good man to watch if you wish to improve your own methods.

The uniform diffusion of daylight makes us underestimate its power. To fully appreciate this try photographing some part of your shop both by natural and artificial light and compare the exposures necessary. Then you will see why we need so much more electric light than of old.

Shop Equipment News

Barnes Hydraulically-Reciprocated Honing Machines, Types Nos. 214 and 212

The two honing machines shown in Figs. 1 and 2 have been developed by the Barnes Drill Co., 830 Chestnut St., Rockford, Ill., especially for automotive production. Fig. 1 shows a multiple-spindle machine for engine blocks, while in Fig. 2 is illustrated a single-spindle machine.

The multiple-spindle machine can have a stroke up to 16 in. There are two driving spindles which each have six integral splines. The spindles run in cylindrical guides 5 in. in diam., and they are driven by means of helical self-oiling steel crown gears. On the bottom end of the reciprocating guides is attached the multiple head which can have from two to eight spindles as desired. Each main spindle drives half the auxiliary spindle.

The hydraulic cylinder for reciprocating the spindles is mounted between the spindle housings, and its piston is attached to the auxiliary head on the center line of the spindles and midway between them. An air cylinder counterbalance is used, which operates directly on the main air line.

All power shafts on the machine are mounted on radial ball bearings. The spur gears have helical teeth and are made from heat-treated steel. A forced-feed lubrication system supplies oil to the ball bearings and sliding surfaces. It is claimed that a mirror-like surface can be secured by means of a honing machine, which can be used on cylinders 19 in. long when equipped with honing stones 4 in. in length.

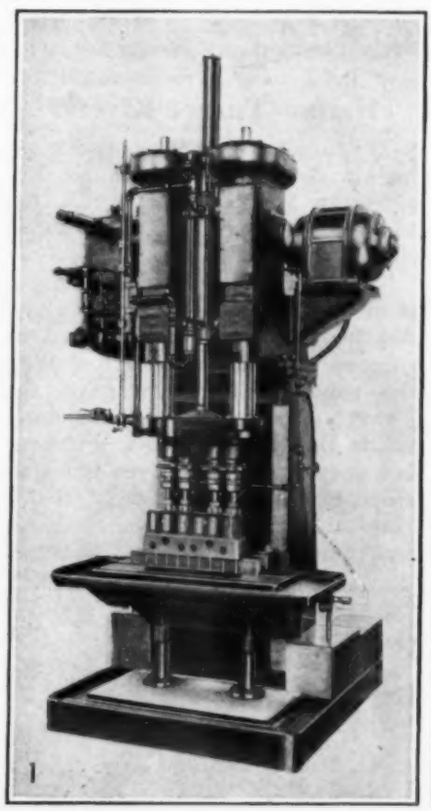
Work-holding fixtures and accessories are not supplied with the machines, since they must be made special to suit the work for which the machine is to be used. Jigs and work-holding fixtures, splash guards and hones can be obtained extra from the company.

The regular table supplied with the machine has a hand-operated screw for the adjustment of the height. When the 16 in. of vertical travel of the spindle is not sufficient to permit lifting the hone out of the work, an air-operated table can be supplied. The air cylinder allows the table to be lowered about 9 inches.

The height of the multiple-spindle machine, overall, is 11 ft. and 7 in. The distance from the center of the spindle to the face of the column is 10⅝ in. The maximum distance from the top of the table to the nose of the multiple spindle is 41 in., while the minimum distance is 3½ in. The work table has a surface of 17x40 in. The vertical travel of the table is 20½ in. The machine requires a 20-hp. motor operating at 1,200 r.p.m. The number of revolutions of the spindle is from 75 to 589 per minute. The number of cycles per minute is from 0 to 75. The floor space required is 61x76½ in. and the weight is about 7,840 lb. with the motor and starter.

The principles of operation of the single-spindle machine are the same as those for the multiple-spindle machine.

The spindles have six splines. A broached cast-iron hub is provided for the crown gear. Both the hub and the splines are self-oiling. A ball bearing coupling connects the spindle to the piston of the hydraulic reciprocating mechanism. The hydraulic cylinder is superimposed directly over the spindle. The arrangement permits the regulation of the stroke to the desired length up to 16 in. and the setting of the stroke so that the hones will extend an equal distance through the bore at each end of the stroke. Stops are provided on a vertical rod which can



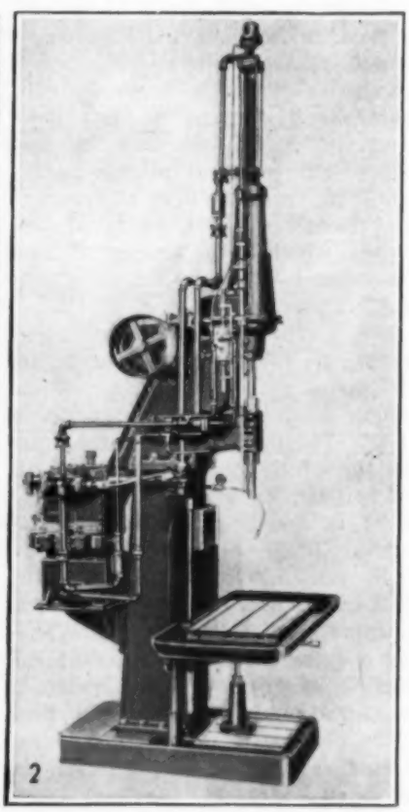


Fig. 1—Barnes Hydraulically-Reciprocated Honing Machine, Type No. 214. Fig. 2—The single-spindle machine, Type No. 212

Shop Equipment News

be rotated. A skip-stop provision permits the raising of the spindle to its uppermost position.

The machine is equipped with a multiple-disk clutch manufactured by the company. The machine clutch lever is so arranged that when pulled forward it simultaneously engages the driving multiple-disk clutch and opens the hydraulic valve so that the rotation and the reciprocation of the spindle begin at the same time. Moving the lever back will stop the machine. A latch on the lever permits hand control of the vertical travel of the spindle without engaging the clutch. This allows the spindle to be brought to the work or lifted out without rotation. The hones can be collapsed without revolution of the spindle.

Any standard types of hones can be used on the machine. Kerosene is used as a coolant, and the hones are flooded while the machine is in operation by means of a coolant pump. It is claimed that the machine will remove approximately 0.0015 in. from the bore of an average reamed cylinder in about one minute, which is the amount of time the cylinder is usually honed in general practice.

The height overall of the single-spindle machine is 11 ft. and 10 in. The distance from the center of the spindle to the face of the column is 11 in. The maximum distance from the top of the table to the nose of the spindle, for a No. 4 Morse taper is 35 in., while the minimum distance is 8 in. The working surface of the table is 17x30 in. and the vertical travel of the table is 12 in. The machine requires a 5-hp. motor having a speed of 1,200 r.p.m. It can operate at from 0 to 75 cycles of reciprocation per min. The floor space required is 57x53 in. and the weight is about 3,400 lb., with the motor and starter.

Ordway Toolmakers' Gage

A toolmakers' gage has been brought out by Nehemiah W. Ordway, 2 Congress St., Hartford, Conn. The gage, shown in the accompanying illustration, is designed especially for the gaging of drill points in grinding. It covers all sizes of drills up to 2⅜ in. A 6-in. graduated scale is also supplied, and the gage

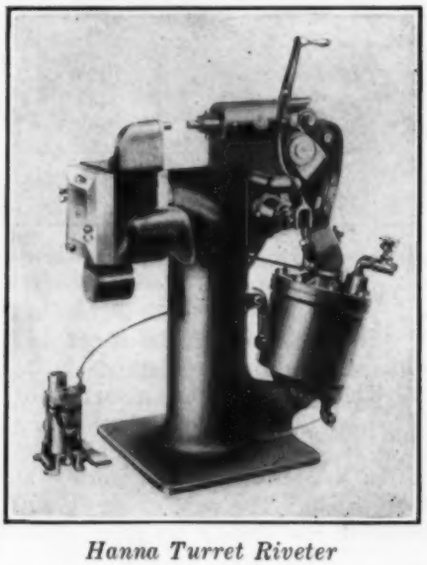
Ordway Toolmakers' Gage

can be used as a square, or as a taper gage in filing the clearance in dies. A miniature size handles small work.

Hanna Turret Riveter

The turret riveter illustrated is being marketed by the Hanna Engineering Works, Chicago, Ill., for use in cold-riveting automobile chassis frames.

The chief feature of this machine is the rotating turret head that carries four horns or noses that can be successively indexed into line with the movable die mounted on the plunger or ram. These noses enter inside the chassis frame, and they are shaped to conform to the open space in the frame adjacent to the various rivets. Since the clearance conditions vary, the horn shapes are likewise varied to meet all possible conditions in the riveting of a chassis frame.



Hanna Turret Riveter

The turret head is mounted on a live spindle made of heat-treated alloy steel that is supported in bearings located in the barrel of the riveter frame. A marine-type thrust bearing carries the thrust resulting from the riveting action. The turret head is locked in position by means of an index pin that selectively engages four holes in the turret spindle. Each hole is bushed with a hardened socket that has a tapered slot conforming to the wedge-shaped flat end of the index pin. The index pin is made of hardened and ground tool steel and is self-locking in the spindle.

The index-pin movement is controlled by a double-acting air cylinder, supplemented by a hand crank by means of which the head is actually indexed. The crank is coupled to the valve of the index-pin air cylinder so that when the operator pulls the crank handle out about 3 in. the index pin is withdrawn. The crank is then rotated 90 deg. and the turret rotates to the next station, after which the crank is released and allowed to return to its former neutral position. The index pin at the same time drops into its new position. The turret can be rotated independently by moving the crank further back. During rotation of the turret spindle, a safety device prevents the index pin from approaching the spindle and scoring it between index holes. The time for indexing is said to be one second.

The riveting mechanism proper is the standard Hanna type such as was described on page 617, Vol. 64, of the *American Machinist*. The principal feature is uniform pressure for a considerable portion of the stroke. Air pressure is used to actuate the piston.

The turret riveter can be furnished with a stationary or a swivel base. With the latter the whole unit is supported on a vertical post that is placed within the column of the frame. Bronze radial bearings and a ball thrust bearing are used. The riveter can be locked in two or more positions by means of a vertical pin in the frame column that engages holes in the base. This pin is geared to the turret index-pin cylinder so

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that both pins are released simultaneously.

The movement of the riveting mechanism is controlled by a standard Hanna valve that is foot operated by heel and toe movements for advance and return respectively. When the riveting die is all the way back, the valve is brought to neutral position by means of a Bowdin wire from the riveting mechanism. The result is that the air intake is shut off on the return stroke, and all air is excluded from the riveter while it is idle. By means of this feature air is said to be conserved. The riveter may be operated fifty cycles per minute.

The machine occupies a floor space of 30x40 in. and is 45 in. in height.

Olsen Locomotive and Car Spring Testing Machine

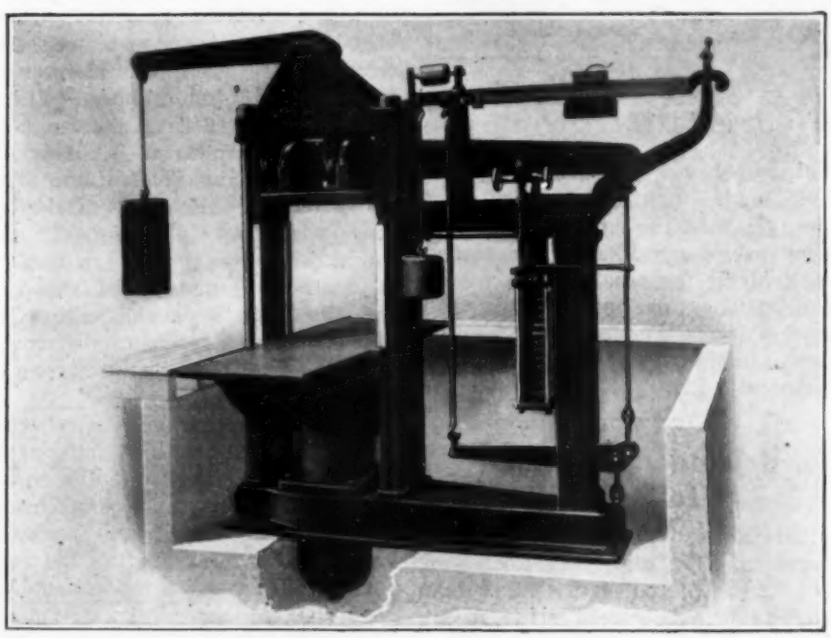
The improved locomotive and car spring testing machine shown in the accompanying illustration has been placed on the market by the Tinius Olsen Testing Machine Co., 500 North Twelfth St., Philadelphia, Pa. The machine is of the hydraulic lever-weighing type.

On the standard machine the table is built level with the floor to reduce the handling. Special tables can be provided, however, with roller bearing carriages on which the springs can be mounted or special trucks can be had on which the springs may be rolled over onto the table for testing.

The weighing system consists of a multiple-lever unit with knife edges inserted in machined slots, ground to an edge. The weighing system terminates in a scale beam which weighs the load to full capacity. The pressure is applied through an accumulator pressure of 1,000 lb. per sq.in. Operating valves are supplied, as well as an annihilator valve to reduce the shocks on the machine. Other accumulator pressures can be provided if desired.

The machine has a clearance between the uprights of 23 in. and between the table and head of 28 in. The stroke of the table is 24 in. The length of the machine is 11 ft. and its width is 6 ft. and 3 in. Its height above the floor is 5½ ft., and its total height is 10 ft. and 1 inch.

Capacities can be had of 100,000, 125,000 and 150,000 lb. Their weights are 10,000, 11,000 and 12,500 lb., net, for the three machines.



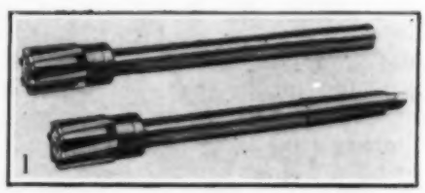
Olsen Locomotive and Car Spring Testing Machine

Wetmore Adjustable Reamers, Types 10 and 11

The types 10 and 11 adjustable reamers with arbors integral, illustrated, and manufactured by the Wetmore Reamer Co., Milwaukee, Wis., are similar in design to the types 2 and 6 previously described on page 1205, Vol. 50, and page 195, Vol. 56, respectively, of the *American Machinist*. The latter reamers are manufactured with separate arbors.

Left-hand angle cutting blades are used in the reamers so that they will not "dig in" and in order to eliminate the chatter. The front cutting edge of each blade is set on a 3-deg. angle to provide the rake for the cutting edge. The threads of the reamers are milled on centers so that they will be concentric. The blades adjust forward to increase the diameter. They are made from high-speed steel. The bodies and parts of the reamers are made from heat-treated alloy steel.

Fig. 1 shows the type 10 standard reamer with taper and straight-shank arbors. Adjustments to 0.001



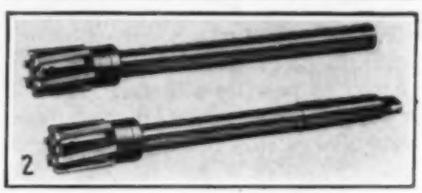


Fig. 1—Wetmore Adjustable Reamer, Type 10. Fig. 2—The heavy-duty reamer, type 11

in. can be made in the diameter of the reamers. The range of sizes is from 1 to 2⅛ in. in sixteenths of an inch.

In Fig. 2 is shown the type 11 adjustable heavy-duty reamer with taper- and straight-shank arbors. A large range of adjustment is provided to allow for wear and regrinding. The blades project ¼ in. over the end of the reamer body so that chips will not clog up the blades. The type 11 is also made in a range of sizes from 1 to 2⅛ inches.

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Precision Gauge & Tool Co. "Friction-Less" Live Center

The Precision Gauge & Tool Co., 6482 Epworth Blvd., Detroit, Mich., is manufacturing the "Friction-Less" live center, illustrated. The tool can be adapted to any size or style of lathe by using various removable taper shanks.

The live center proper is made of tool steel and has a 60-deg. point. It is mounted on two roller bearings, the forward bearing being of the tapered radial-thrust type, and the

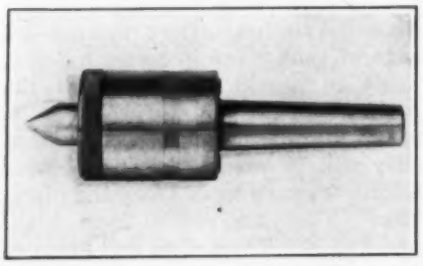


Fig. 1—Precision Gauge & Tool Co. "Friction-Less" Live Center

rear bearing, the Hyatt spiral-wound, straight-roller type, floating free. The tapered roller bearing is adjusted by means of the knurled end cover. The outside cup-race has a sliding fit in the hardened and ground steel body and is prevented from rotating by means of a pin that engages a groove. Reaction against the adjustment of the bearing is provided by means of a composition pad of resilient material separated from the outer race by a leather pad and a steel washer. The cross-sectional view shows this construction, which

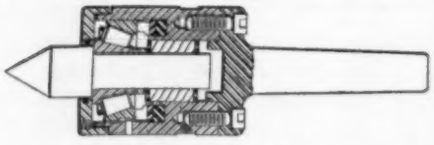


Fig. 2—Cross-section of the center

is said to absorb shock and to compensate for wear as well as for expansion due to heat.

A felt seal is provided in the end cover to prevent oil leakage. Any size taper shank can be furnished and can be attached to the body of the live center by means of cap screws. Model BB is for use with taper shanks up to No. 4 Morse or No. 12 Jarno. The outside diameter of the body is $2\frac{11}{16}$ in., the overhang $3\frac{5}{8}$ in., and the overhang of the center point beyond the body is $1\frac{1}{2}$ inches.

Model CC is for use with larger shanks than Model BB. The outside diameter of the body is $2\frac{7}{8}$ in., the overhang of the body $3\frac{7}{8}$ in., and the overhang of the center point beyond the body is $1\frac{5}{8}$ inches.

The center can be furnished integral with the tailstock on either old or new lathes.

Bonney Wrench Kits

Two additional lines of chrome-vanadium wrenches have been placed on the market by the Bonney Forge & Tool Works, Allentown, Pa. Fig. 1 illustrates the millwright's kit, while in Fig. 2 is shown the loom fixer's kit.

The millwright's kit consists of

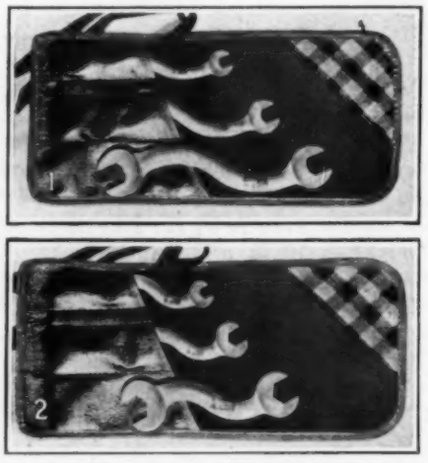
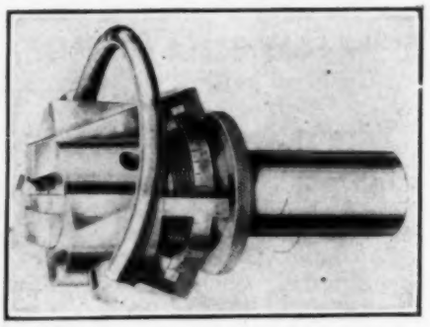


Fig. 1—Bonney Millwright's Wrench Kit. Fig. 2—The Loom Fixer's Kit

"S" wrenches designed for the work and made lighter, thinner and stronger than the earlier type. The loom fixer's wrenches are designed particularly for repairmen in textile mills. They are of a short and stocky design and are heat-treated. Both sample sets are furnished in a leatherette kit.

Reisinger Adjustable Hollow Mill

The Reisinger Machine Tool Corporation, 839 Lake Ave., Rochester, N. Y., has placed on the market an adjustable hollow mill made in six sizes, giving a cutting range from $\frac{1}{16}$ in. to $2\frac{1}{2}$ in. The hollow mill, which is shown in the accompanying illustration, has a graduated adjustable dial that moves the blades backward or forward the amount needed to set the tool. A single-action locking lever locks or releases all of the cutters at the same time. No



Reisinger Adjustable Hollow Mill

wrenches are required to make adjustments. The features claimed for the hollow mill are accuracy, quick adjustment, and a minimum number of tools for a wide range of cut diameters.

Electric Controller & Manufacturing Co. Synchronous Motor Control

A self-contained oil-immersed automatic control for 2,300-volt synchronous motors has been brought out by the Electric Controller and Manufacturing Co., Cleveland, Ohio. The control is designed both for across-the-line starting of slow-speed motors, and for reduced-voltage starting of higher-speed motors. The reduced-voltage starter is shown in the accompanying illustration. The control for full voltage is of similar appearance but of slightly less height.

To start the motor with the control the operator pushes a button, and as the motor reaches synchronous speed the field excitation is automatically applied.

The reduced-voltage control consists of a welded tank of boiler plate inclosing an automatic double-throw switching mechanism, a power transformer for starting, and potential transformers for providing 220 volts for the master-switch operating current and the current transition relays. The latter connects the motor

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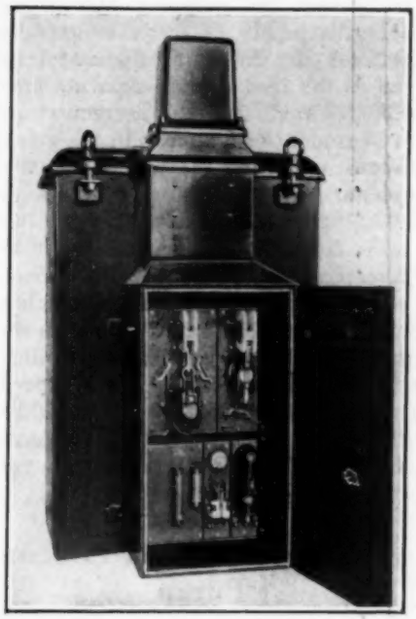


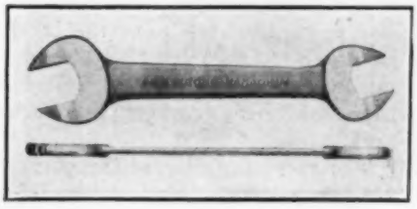
Electric Controller & Manufacturing Co. Synchronous Motor Control

to full voltage when it has been accelerated to about 85 per cent of synchronous speed. The full-voltage control is similar to the reduced-voltage control, except that the starting transformer is omitted. The units are completely contained, and arranged for mounting on the floor.

Armstrong Chrome-Vanadium Steel Wrench

The Armstrong Bros. Tool Co., 315 North Francisco Ave., Chicago, Ill., has placed on the market the chrome-vanadium steel wrench shown in the accompanying illustration. The design of the wrench is an improvement over that of the alloy steel wrench which has been manufactured by the company for some time.

The wrench is drop-forged and heat-treated. It is finished in nickel over copper and the heads are buffed bright. The jaws are of a thin and narrow design. All standard sizes are manufactured by the company.



Armstrong Chrome-Vanadium Steel Wrench

National Semi-Hot, Automatic-Feed, Bolt-Heading Machines, $\frac{3}{8}$- and $\frac{5}{8}$-Inch

The National Machinery Co., Tiffin, Ohio, is marketing a $\frac{3}{8}$-in. and a $\frac{5}{8}$-in. semi-hot rivet and bolt heading machine with an automatic feed. The machines are similar in design to the 1-in. machine described on page 354, Vol. 58, of the *American Machinist*. Many features of the high-duty forging machine described on page 257, Vol. 64, are also present in this machine.

The $\frac{3}{8}$-in. machine will do a variety of single-blow work up to $\frac{3}{4}$ in. in diam. and $4\frac{1}{2}$ in. in length. The $\frac{5}{8}$-in. machine handles work up to $\frac{5}{8}$ in. in diam. and 7 in. in length. Fig. 1 shows the $\frac{3}{8}$-in. machine. The semi-hot process is said to give a clean finished product in one blow, using cheaper stock than is necessary for cold work.

In both machines the bed frame is short and massive. The heading slide, Fig. 3, is greater in length than the distance from the main shaft to the breast plate. The suspended over-arm gives the slide a bearing in back of the crank that also guides the front end and is said to prevent the heading tool from "winking" or being thrown out of alignment when making bolts that require a large amount of stock. The bearings are at the top of the slide and are out of the zone of scale and water so that they will not be affected by them.

The bolster plate is designed so that the heading tool is always supported firmly and does not overhang even when making the shortest piece, since various lengths of bolster

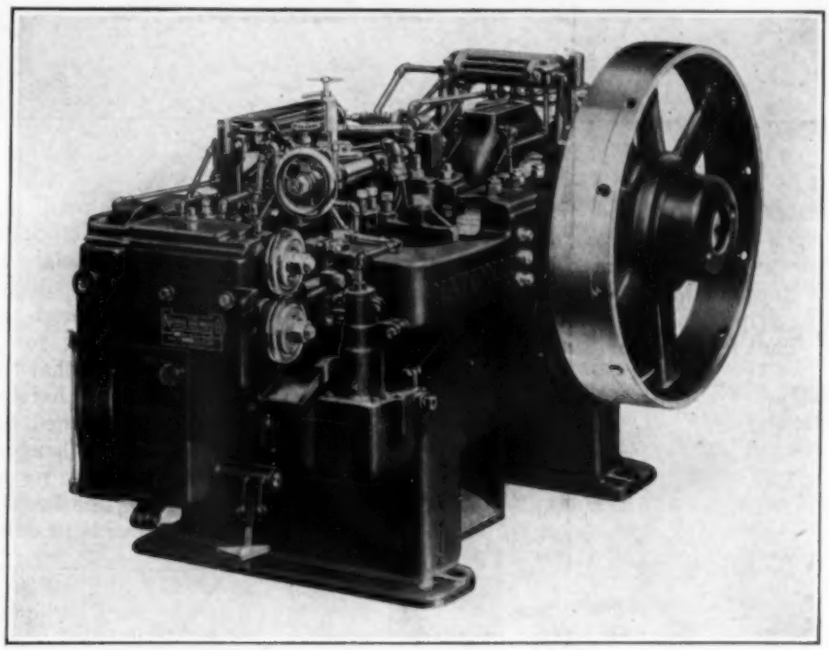


Fig. 1—National Semi-Hot, Automatic-Feed Bolt-Heading Machine, $\frac{3}{8}$-Inch

Work may be fed into the $\frac{3}{8}$-in. machine from coil stock where long runs on a single size are being made. A long furnace with a small dimensioned heating chamber is employed. The stock is first taken off the original coil and rewound into coils of large diameter by the National coiler shown in Fig. 2, then fed through the heater to the heading machine. An electric butt welder is used in conjunction with the coiler so that one coil is joined to another to make the heading operation continuous. Single feed rolls of large diameter are used in the $\frac{3}{8}$-in. machine, while double rolls are used in the $\frac{5}{8}$-in. size.

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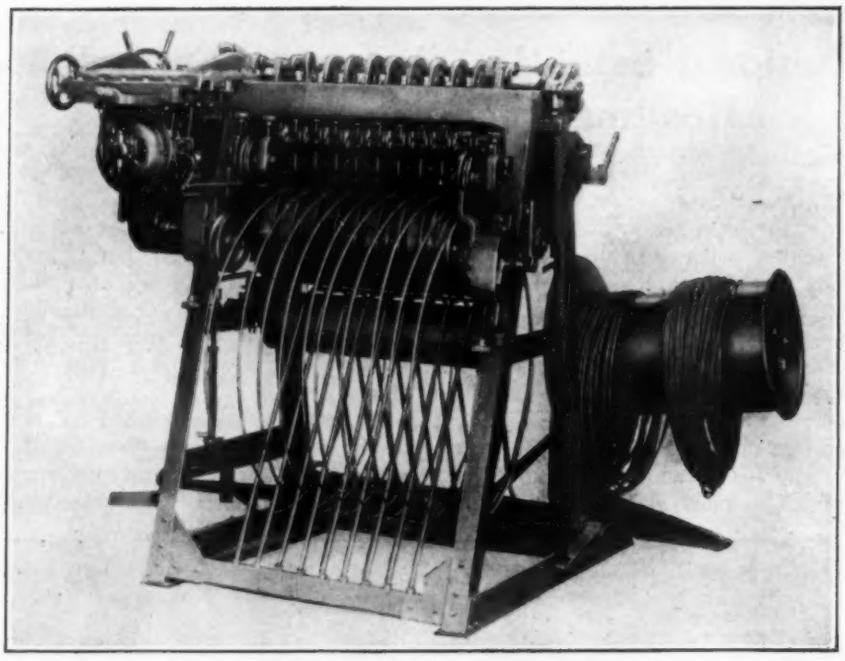


Fig. 2—Coiler for use in ⅜-in. Machine

plates are furnished. The plate is screw-controlled in all directions to permit rapid and accurate alignment of the heading tool with respect to the grip dies.

The feed mechanism, shown in

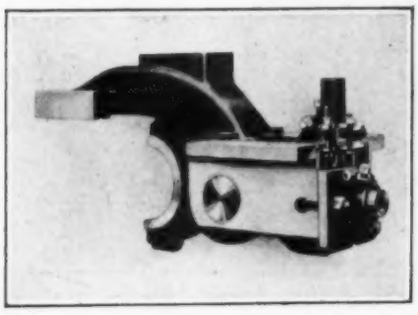


Fig. 3—Construction of the heading slide

Fig. 4, is set at an angle to the machine proper and as a result the material is sheared at an angle. This design is said to eliminate distortion of the bar that occurs from square shearing and that prevents the stock from being centered in the head. Consequently it is possible to upset a large amount of stock. The range of the machine includes square- and hexagon-head machine bolts, special track bolts, and similar pieces that require considerable material in the head.

An adjustment is provided to vary the gripping time to suit various classes of work. On work requiring small gather, the heated stock is gripped for a time only sufficient to make the upset, while on work requiring more stock in the head the gripping dies hold the stock for a longer period. It is claimed that the life of the dies is prolonged thereby. The same result is also claimed for the patented grip-relief mechanism, which, while providing all the necessary gripping pressure, limits the ultimate pressure obtainable in order to prevent the gripping dies from being battered. If a sticker gets in between the dies, an automatic trip causes the feed rolls to separate and stop feeding. Thus an accumulation of bent and twisted stock in the grips is prevented and the time necessary to remove this material is saved.

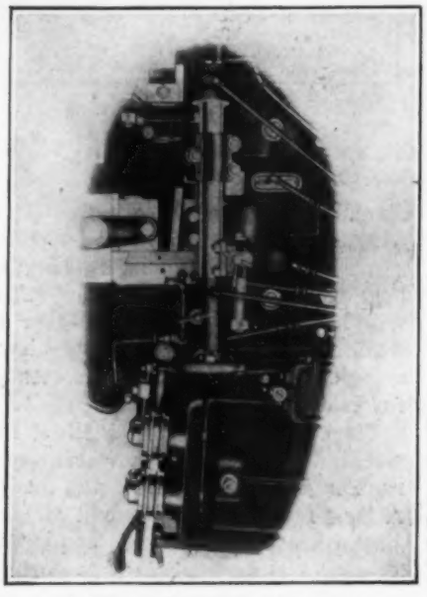


Fig. 4—Angular feed and shear mechanism

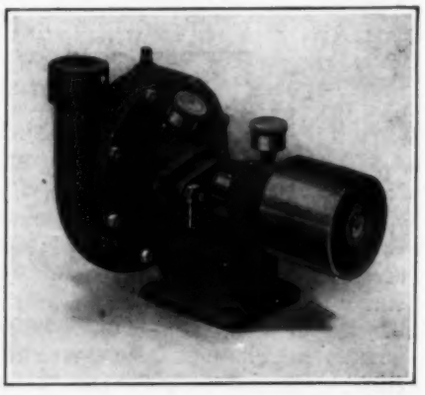
A patented ejector pushes the work from the dies and allows it to drop free so that the piece cannot rebound and catch in the advancing head. The fifty-seven bearings in each machine are automatically oiled.

The ⅜-in. machine has a speed range from 150 to 200 r.p.m., while the ⅝-in. machine has a speed range from 120 to 150 revolutions per minute.

Goulds Centrifugal Coolant Pump

A small centrifugal pump for handling the cooling compound for machine tools has been placed on the market by Goulds Pumps, Inc., Seneca Falls, New York.

The pump, although small, has a large capacity for work of this sort. The design is such that it will pass chips without clogging or producing



Goulds Centrifugal Coolant Pump

undue wear. The casing is bolted to the frame with eight studs, and by shifting the casing with respect to the frame the discharge can be placed in any one of eight directions. The pump itself will operate in any position. It is driven by means of an overhung pulley and belt. A bronze bushing carries the thrust load.

The rated capacity of the pump is 20 gal. per min. at a pressure of 9 lb. per sq.in. when the pump is operating at 1,750 rev. per minute.

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Potter & Johnston Special Automatics For Brake Drums

The Potter & Johnston Machine Co., Pawtucket, R. I., has modified its manufacturing automatics, for finishing Ford brake drums. Fig. 1 shows a modification of the model 6 D machine, while Fig. 2 shows a modification of the 6 A machine. In both cases the tools are revolved and the work is indexed in the turret heads instead of the usual reverse practice. Magnetic chucks, made by the O. S. Walker Co., Worcester, Mass., are used on the machines.

The brake drums are carried to the machine, shown in Fig. 1, on a conveyor. The operator sits above the machine and places each drum on the horizontal face of the chuck in the top position of the turret. Two pins in the face of the chuck engage two of the rivet holes previously perforated in the brake drum and center it. The magnetizing current automatically is thrown on when the chuck has been indexed to about the 45-deg. position.

The revolving tools, which are held in a modified faceplate, face the end of the drum flange and chamfer it both inside and outside. To insure completion of the cut the tools are revolved 1½ times. The cutting feed is ⅜ in. per min. for the worst condition.

While the cut is being taken the turret slide is locked in place by means of an arm having a slotted end, which can be seen in the central part of the illustration. The turret slide travels 3½ in. and a spring-actuated bumper is used to absorb the shock of deceleration from the quick initial advance to the slow cutting advance.

The piece is ejected by means of stripper pins when the magnetic chuck is again horizontal but in its lowest position. Indexing takes place on the dwell of the turret slide and is governed by a Geneva stop motion. The standard 6 D automatic construction provides for the withdrawal of the lock-bolt before indexing is possible.

Fig. 3—Construction of Walker magnetic chuck

The revolving cutter used in the modified 6 A manufacturing automatic, Fig. 2, is of the inserted-tool type. As in the case of the 6 D machines the brake drums are located on the faces of the magnetic chucks by means of pins that engage the rivet holes. No stripper pins are used to release the work, however, and instead the sudden jolt of indexing is relied upon to accomplish this object. The magnetizing current comes on after indexing starts.

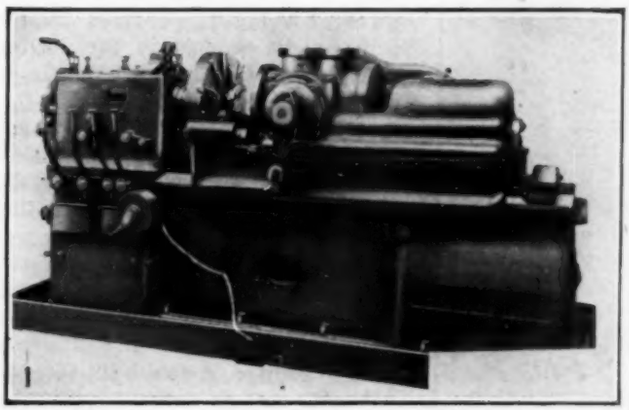
In Fig. 3 the construction of the Walker magnetic chuck can be seen. Six segmental pole pieces are provided. They are shown in the rough in the left side of the illustration and their shanks are shown protruding through the rear of the face plate in the upper right corner of the illustration. The six metal tubes are bushings for guiding the ejector pins, while the two plates form the back cover of the chuck.

Except for loading, both these modified machines are fully automatic. The production obtained is claimed to be about 600 pieces per hour.

Brown & Sharpe Cutter Testing Fixture

The cutter-testing fixture illustrated is being marketed by the Brown & Sharpe Manufacturing Co., Providence, R. I., for use in testing formed cutters and hobs. All sizes of cutters up to 10 in. in diam. are within the capacity of the fixture.

The cutter to be tested is mounted on a fixed stud, while the testing device is adjustable and slides in guides. The testing plate proper is carried in turn on a vertical guide that is adjustable by means of a knurled wheel and micrometer screw. The position of the plate is indicated on a scale graduated in fiftieths of an inch. The vertical movement of the plate permits the testing of cutters whose faces are either radial or



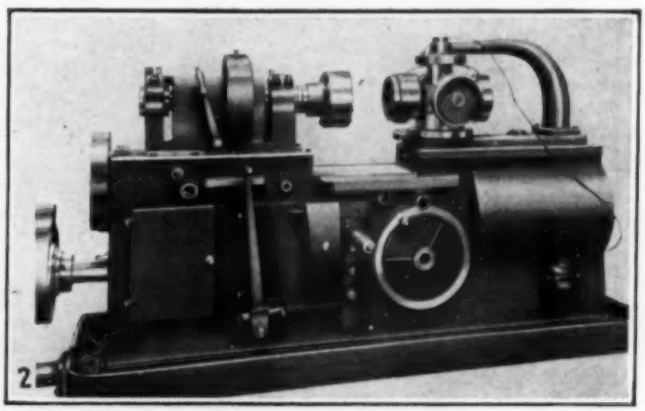


Fig. 1—Potter & Johnston Special Automatic for brake drums, Model 6 D. Fig. 2—The Model 6 A Special Automatic for brake drums

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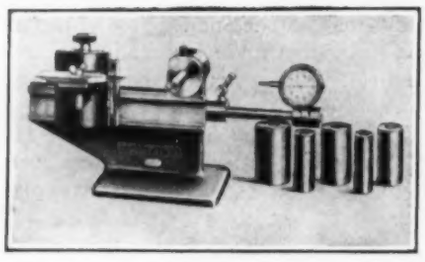


Brown & Sharpe Cutter-Testing Fixture

undercut. One end of the test plate is flat and is for use for testing straight-gashed cutters or hobs. The other end is made in the form of a knife-edge to permit the testing of spiral-formed cutters or hobs.

The dial indicator can be furnished to read in thousandths of an inch or hundredths of millimeters as desired.

Five hardened and ground bushings are supplied with the fixture in the following sizes: ⅞, 1, 1¼, 1½ and 1¾ in. in diam. A collar is also provided for use when testing thin cutters on the fixture if necessary.

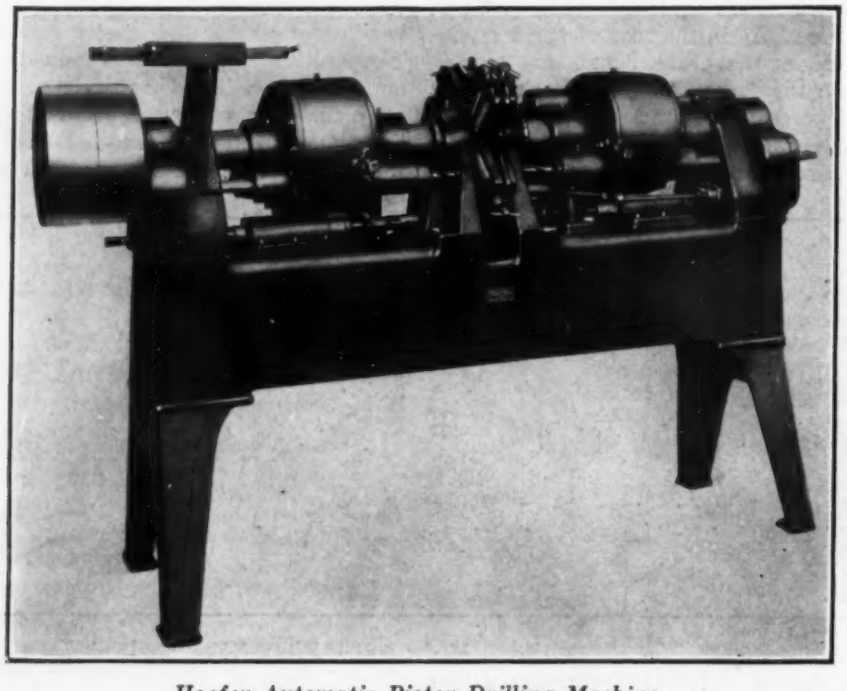
Hoefer Automatic Piston-Drilling Machine

The automatic piston-drilling machine shown in the accompanying illustration is one of a line of piston-pin drilling machines built by the Hoefer Manufacturing Co., Freeport, Ill. The machine is essentially similar in design and construction to the hand-operated tool previously described on page 767, Vol. 64, of the *American Machinist*. It is intended for drilling the piston-pin holes in cast-iron or alloy pistons.

The pistons are carried on a four-position trunnion fixture. In the first position the fixture is loaded. In the next position the holes are rough-drilled from each side. In the third position the hole is finish bored straight through with a piloted bar that can carry one or two cutters as desired. In the fourth position the hole is reamed straight through by means of a piloted reamer.

The feed of the various tools is set according to the material in which they are working and is relatively proportioned so that each is operating at the correct cutting speed of cast-iron or alloy pistons.

The trunnion can be indexed either manually or automatically, as desired, so as to leave the operator free to only load and unload the machine which can be made to chamfer as well as to perform other operations. The feeding of the machine is controlled by means of cams so that the operator has only to trip a lever to start the cycle. When the cycle is completed the tools return to their starting position and the feed stops. It is claimed that from 90 to 120 pistons can be drilled, bored and reamed per hour on the machine. For production work the machine described on page 805, Vol. 64, of the *American Machinist*, is recommended. It is claimed that the latter will complete 250 to 360 pistons per hr. with 0.001-in. accuracy.



Hoefer Automatic Piston-Drilling Machine

Goodell-Pratt Electric Drills

The Goodell-Pratt Co., Greenfield, Mass., has taken over the line of electric drills formerly made by the A. F. Way Co., of Hartford, Conn., under the name of the "Arnold" drill. It has made many modifications and improvements in the drills and will market them under the Goodell-Pratt trademark.

The bearings for the armature shafts are of the sleeve type, lined

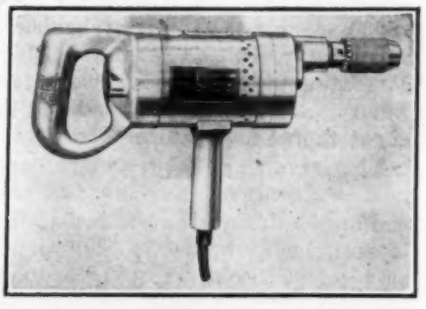


Fig. 1—Goodell-Pratt Electric Drill, ⅜-Inch

with No. 1 Dutch Boy babbitt. The bearings for the drill spindle are of Bunting bronze. All bearings are provided with a wick oiling device to keep them well lubricated. A ball thrust bearing is provided on the drill spindle to sustain the drilling pressure so that the machine can be subjected to heavy-duty service.

High-speed motors of the wound rotor type are used on the smaller drills. These motors will run equally well on either direct or alternating current. Speed reduction is secured through a train of hardened steel gears running in a closed chamber that is filled with a special paste lubricant to insure long life and quiet running. A fan, built integral with the motor armature, insures ample ventilation to keep the motor cool.

The drills are made in several

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sizes and types, having capacities of ¼, ⅜, ½, and ⅝ in., for both light and heavy duty. The smaller tools are made with a pistol grip and provided with a special trigger switch that does not have to be held down by the operator while the tool is in service. When the switch is closed by a pressure of the finger it remains in this position until released by pressing a button on the side of the handle.

The releasing button is located where it is under the operator's thumb as he gasps the handle in a normal way. If the drill should

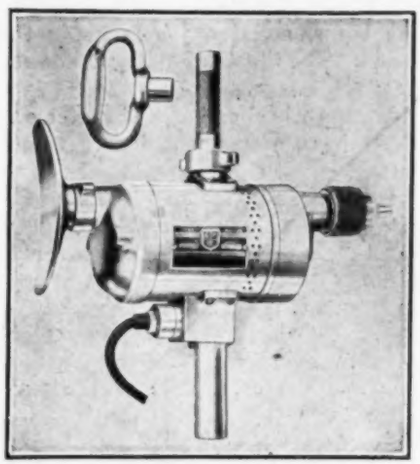

Fig. 2—Heavy-Duty Drill, ⅝-Inch

catch when breaking through, or for other reason, the movement of the drill body is in a direction that will cause the releasing button to be pressed almost automatically.

Fig. 1 shows the ⅜-in. standard drill. The drill spindle in this type is offset so that the tool may be used to drill a hole close to an adjoining parallel surface; the limiting distance being the radius of the chuck sleeve. Fig. 2 shows the ⅝-in. heavy-duty drill, fitted with two handles, in one of which is the starting switch. The loop handle of the drill is detachable, and a breast plate may be substituted for it, as shown in the illustration.

A feature of these drills may be found in the manner of attaching the cable through which the electric current is conducted to the motor. The limiting stops, are provided for the sleeve through which the cable passes has a tapered hole, and to this hole are fitted three serrated jaws (four in the larger sizes) like the jaws of a drill chuck. When the plug through which the cable passes is screwed down upon the outer ends of the jaws, the latter are closed in upon the cable. The claim made for this feature is that a very strong grip is obtained upon the cable.

Bench stands, with screw feed and limiting stops, are provided for the larger sizes of drill, by means of which the tools may be converted into substantial bench drills.

Heald Grinding Machine for Cylinders of Air-Brake Pumps

The Heald Machine Co., Worcester, Mass., has brought out a machine especially adapted to grind the cylinders of the steam-driven compound air pumps that are carried upon practically all locomotives as a part of the train-braking system. It is a modification of the regular No. 50 Heald cylinder-grinding machine in which the weight has been greatly increased and the bed extended. The feature of the machine is a rotatable fixture, built as a part of the machine table, in which the four assembled cylinders of compound air-brake pump may be quickly and accurately secured in position to bring the original center lines of the pump cylinders into alignment with the table traverse of the grinding machine so that all four cylinders may be ground at one setting.

In respect to the wheel-head and the table driving mechanism it does not differ materially from the regular No. 50 Heald machine previously described on page 975, Vol. 56, of the *American Machinist*. The reciprocating movement of the table is actuated by the hydraulic mechanism that is standard upon all Heald machines, by which the rate of traverse may be varied at the will of the operator from zero to maximum by the single movement of a controlling lever. An electric motor, attached to the base at the rear, supplies power to drive the grinding wheel and to actuate the cycle movements of the machine.

Fig. 1 shows a front view, with the assembled cylinders in place in the fixture and ready to grind. Figs. 2 and 3 show the details of the fixture, both ends of which are practically identical, and displays the manner of locating the work so that the regrinding will take place along the original center lines of the cylinders, regardless of any wear to which the cylinder walls have been subjected.

While the job is still on the floor, the aligning bars *AA* are put through the bores of the respective pairs of cylinders and the locating

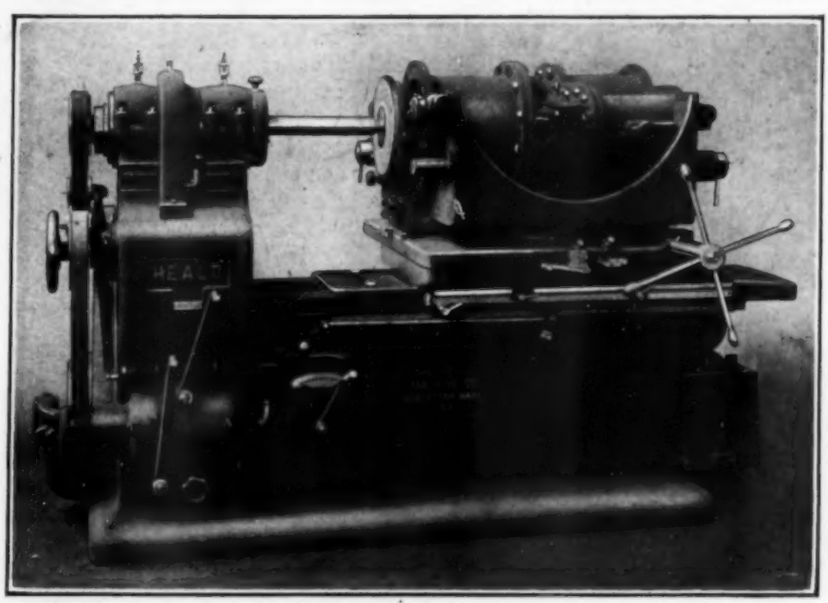

Fig. 1—Heald Grinding Machine for Air-Brake Pumps

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disks *BB*, which are provided with comparatively long hubs to fit the bars closely, are placed upon the bars. There are four of these disks, two for the large and two for the small cylinders of the pump, tapered upon the peripheries to match the beveled counterbores to be found at each end of the pump cylinders. As these counterbores are made at the time the pump is built, they presumably represent the original

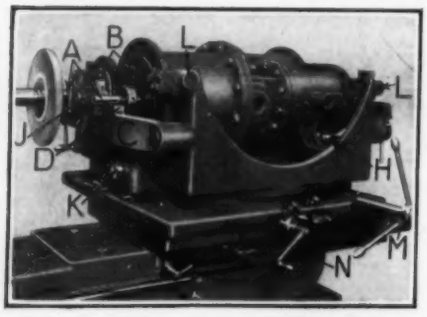

Fig. 2—A view of the fixture

alignment, and as they are not subjected to wear they may be depended upon to relocate the cylinders in accordance with that alignment.

With the bars and disks in place in the cylinder bores and the disks drawn snugly to bear in the counterbores by tightening the ring nuts on each bar, it is evident that the center line of each bar will coincide with the original center line of that pair of cylinders in which it is secured. In this shape the casting is lifted by the shop crane and deposited in the fixture.

At each end of the fixture there is a cross-bar *C*, having hardened and ground steel plates *DD* permanently secured to its upper surface. One end of each bar swings upon a stud projecting from the body of the fixture, while the other end rests upon a collar *E*, which may be rotated about its supporting stud, and a portion of the periphery of which is flatted as shown. The level of the plates *DD* relative to the center line of the grinding machine is such that when taken in conjunction with the radius of the bars *AA* resting upon them, the center lines of the latter will coincide with that of the grinding machine in a horizontal plane.

Though the heavy casting is located in the fixture by the bars *AA*, the latter do not have to carry any appreciable weight. Four large spring plungers, one of which may be seen at *H* in Fig. 2, receive the load, though they have nothing to do with locating it at this time. The compression factor of the springs is so calculated that there is a slight overbalancing weight resting upon the bars; which are therefore responsible for the location.

The center lines of the bars *AA* (which coincide with the center lines of the cylinders) now being coincident with the center line of the grinding machine in one plane, are brought into parallelism with that center line in the other plane by means of the hand-operated cams *J*, of which there is one on each of the cross-bars. A line drawn through the axes of the studs upon which the cams *J* turn would accurately parallel the center line of the grinding machine. When these cams are turned by moving their handles, the result is to wedge the bars *AA* apart equidistantly from the centers of the studs, and thus to bring them, also, into parallelism with the centerline of the grinding machine.

If the centerlines of the two pairs of cylinders are not parallel—a condition that may easily obtain because of the breakage and repair to which this class of machinery is peculiarly subject—the bars *AA* will not be parallel; they will be more widely separated at one end than at the other. They will, however, be disposed at equal angles on either side of a true center line, to divide any error existing in this respect between the two pairs of cylinders; hence the newly ground bores will be parallel, with a proportionate amount of the error corrected in each pair.

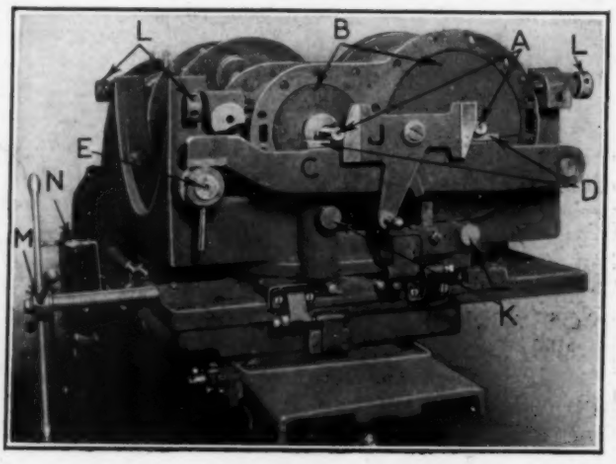

Fig. 3—Details of the fixture

Having thus established the location of the cylinders in the fixture, a capstan-head setscrew *K* is now tightened upon each of the four spring plungers *H*, fixing the position of the latter and allowing them to bear all of the weight. Other capstan-head setscrews *L* (of which there are also four) are set in to bear against the flanges of the cylinders and the casting is now securely held in the fixture independently of the means of locating it, and bearing solely upon the cylinder flanges.

The collars *EE* are now turned to bring the flat portion of the periphery uppermost, allowing the cross-bars to drop away from the ends of the aligning bars *AA* and leave the work entirely supported by the plungers *H* and the large setscrews *L*, before mentioned. The cross-bars are now removed from the fixture, the aligning bars and their disks taken out of the bores, and the job is ready to grind. The illustration Fig. 1 shows it at this stage.

With a wheel of large diameter on the spindle of the machine the first large cylinder is ground. The fixture is then rotated 180 deg. upon its bearing stud by means of the capstan wheel *M* and the second large cylinder is ground without having disturbed any other adjustment. A wheel of smaller diameter is then substituted for the larger one and the cross-slide of the machine advanced by means of the crank-handle *N* to bring the second pair of cylinders into position for grinding. After grinding the first small cylinder, the fixture is again rotated 180 deg. to bring the second small cylinder to the grinding position.

The positions of the cross-slide necessary to bring the separate center lines of the cylinders coincident with the center line of the grinding machine are governed by

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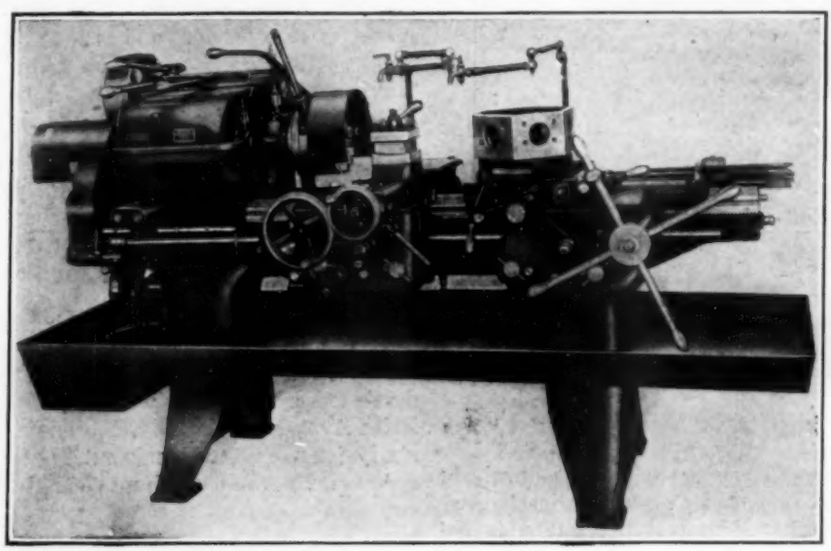
adjustable stops, and the rotatable fixture locks in each of the 180 deg. positions; so that to grind the four cylinders, but one setting of the casting, one change of grinding wheel, one complete rotation of the fixture (in two stages), and one movement of the cross-slide are required.

The floor space occupied by this machine is 60x120 in., and the weight is 9,000 lb., net.

Foster Universal Turret Lathe, No. 1-B

The Foster Machine Co., Elkhart, Ind., has brought out a universal turret lathe, No. 1-B, incorporating improvements over the previous design as described on page 953, Vol. 51, the *American Machinist*. The new features consist of a split-ring type of binder for the hexagon turret, a power rapid-traverse unit for the turret slide, a longer bed to permit greater longitudinal feeding movements, and an increase in swing over the ways and cross-slide. The improved machine is shown in the accompanying illustration.

The turret binder grips almost entirely around the turret on a large diameter, and is operated by a convenient lever. The power rapid-traverse unit is mounted on the rear side of the saddle, and is controlled by a lever within easy reach of the operator. The movement of the rapid traverse can be stopped automatically at any point. The clutches are of large diameter, and the friction contacts are bronze against cast iron.



Foster Universal Turret Lathe, No. 1-B

The cross-slide extends entirely across the bed, and has a working travel of 10 in. On the rear of the cross-slide a pad is provided for mounting tools in back of the work. The cross movement has 12 reversible power-feed changes. The longitudinal feeding movement of the carriage is 32 in. There are six adjustable stops for the automatic stopping of the longitudinal feeding movements of the carriage.

The hexagon turret has a turning movement of 30 in., with 12 feed changes independent of those for the cross-slide and carriage. Each face of the turret is tapped for separate pipe lines, and independent stop-screws are carried in a spool in the rear of the saddle. These stop-screws index in unison with the turret faces.

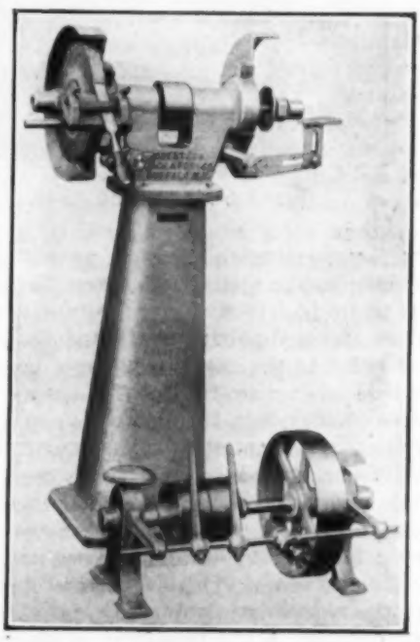
The spindle of the machine is turned from a hardened chrome-manganese steel forging. The hole through the spindle is 2⅛ in. The gears in the head run in a bath of oil. Twelve spindle speeds are obtained through the gear combinations which are effected by the movement of four levers. The head is cast integral with the bed, which is of the reinforced double girder type. The automatic chuck is of the master collet type with a capacity of 2 in. The mechanism can be supplied for either draw-in or push-out types of collets. The swing over the bed is 17 inches.

A countershaft is regularly supplied with the machine, or it is furnished with a motor mounted on the rear of the leg, or on top of the head, if desired. A threading attachment of the leader and follower type, and a taper attachment for turning tapers up to 3 in. per ft., are supplied for the machine. The company also announces that it carries an extensive line of standard tools for the machine.

Robertson "Economy" Tool Grinder, No. 12

The W. Robertson Machine & Foundry Co., 56-58 Rano St., Buffalo, N. Y., has placed on the market a heavy duty "economy" tool grinder, No. 12. The machine is shown in the accompanying illustration. It is heavily built throughout, and has a special high-carbon steel spindle running in self-oiling bearings.

The bearings are of sleeve shape, 4¾ in. long, made of special metal.



Robertson "Economy" Tool Grinder, No. 12

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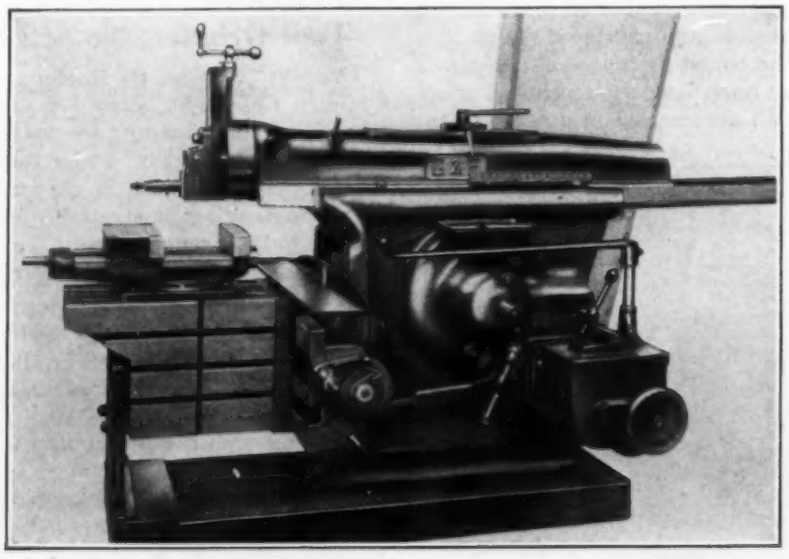
A felt wick fitted through a slot on the bottom of the bearing carries the oil over the full length.

Other features of the machine include safety nuts, a balanced pulley keyed to the shaft, and an adjustable safety guard. The grinding rest is adjustable, and a special rest is also built for the grinding of chisels and other beveled tools. The machine carries two wheels in sizes up to 12x2 in. with a 1-in. hole. A countershaft is supplied with the grinder.

Gould & Eberhardt Shapers, Improved

A number of improvements have been made in the line of shapers manufactured by Gould & Eberhardt, Newark (Irvington), N. J. The improved 32-in. "Invincible" is illustrated. The basic design remains the same, and the outward appearance of the machines has not been greatly changed.

An automatic forced-feed lubricating system is provided that takes care of all reciprocating sliding surfaces, including the ram, as well as all rotating shafts and gears. The oil pump is driven at constant speed from the main drive shaft and the oil is led to the bearing surfaces by means of copper tubes. The pressure of the oil in the system is controlled by means of a by-pass valve. Provision is made to return the overflow to a reservoir in the base of the machine, from where the oil flows over dams and through screens to the pump sump. The level of the oil in the reservoir is observed through an opening in the base that is also used for filling.



Gould & Eberhardt 32-in. "Invincible" Shaper, Improved

The ram bearings are lubricated at all positions of the stroke by means of the pressure system. On the operator's side of the machine there is a window through which the oil may be seen as it is forced to the ram bearings. Wipers and drainage canals are provided so that the oil will not run down the outside of the machine.

A protecting guard for the sliding ram is secured to the rear of the machine. It not only prevents injury to workmen, but also protects the ram bearings from abuse. Any oil that drips on the guard is returned to the reservoir.

The top of the table has been extended and the T-slots are machined to permit the accurate location of fixtures. The base of the machine has also been lengthened to secure better support for the table. The supporting member has two vertical slots for locking bolts and a wide base that rests on a removable bar secured to the machine base.

Power is transmitted from the drive shaft, the end of which is splined to a disk clutch that is mounted on Timken roller bearings. The position of the shear pin in the clutch may be changed so that a light or heavy load can be carried. The clutch is controlled by a long lever convenient to the operator and the machine is automatically braked.

The vise is of the plate-type and is bolted to the table with T-head bolts in the regular slots. A stop pin is provided to prevent the vise from being pushed off the table. This improved vise has its jaws close to the table, and its angular graduations are on a large diameter. It is stated that the vise will not creep when the bolts are loosened for angular adjustment.

The 16- and 20-in. shapers run at 450 r.p.m., while the 24- and 32-in. shapers run at 540 r.p.m. The 16-in. "High Duty" and the 20-in. "Standard" require 3 hp. The range of cutting speeds is from 10 to 130 strokes per min. The floor space is 84x48 in. and the net weight 3,880 lb. The 20-in. "High Duty" and the 24-in. "Standard" also require 3 hp. The range of cutting speeds is from 7 to 108 strokes per min. The floor space is 95x49 in. and the net weight 4,100 lb. The 24-in. and 32-in. "Invincible" shapers require 7½ to 10 hp. The range of cutting speeds is from 9 to 115 strokes per min. The net weights are 6,000 and 6,200 lb., respectively.

Unishear Inside Cutter Model O

The model O deep-throat shear shown in Figs. 1 and 2 has been developed by the Unishear Co., 170 Fifth Ave., New York, N. Y., particularly for use where inside cutting is necessary. Holes or shapes can be cut within a sheet of metal without previously drilling a hole to start the cut.

The machine can be used for continuous cutting of both metallic and non-metallic materials by means of a rapidly oscillating blade. Cold-rolled steel, including 14-gage stock, and 12-gage copper can be handled. Fiber ¼ in. thick and rubber up to ½ in. thick can be cut on the shear. The material is drawn through the blades by hand and can be moved as desired to follow the lines of a design previously laid out. The line is always visible while cutting. Small

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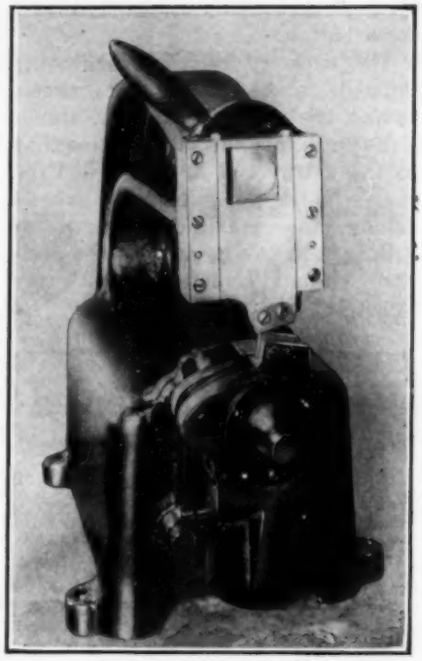

Fig. 1—Unishear Inside Cutter Model O

circles, right angles and straight lines can be cut on the machine without the loss of material and without leaving a burr. In 16-gage metal the average speed capacity is 15 ft. per min. The throat of the machine is 15 in. deep as standard, but machines can be made to order with throats up to 36 in. deep.

The model O "Unishear" is equipped with essentially the same cutting mechanism as the smaller

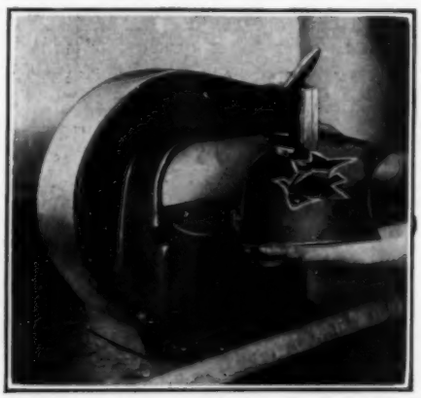

Fig. 2—The machine in operation

improved portable unit previously described on page 951, Vol. 63 of the *American Machinist*. The motor is mounted in an inverted position in the base of the machine and connected to the reduction gears by means of a flexible coupling. The reduction gears are contained in a housing at the front of the machine. By means of an eccentric device the lower shear blade is rapidly oscillated up and down.

The upper blade is stationary and carried on a slide that can be raised or lowered by means of a hand lever operating through an eccentric, as can be seen in Fig. 1. When the slide is raised, work can be inserted in the machine between the blades. The upper blade can then be lowered onto the work and the machine will start the cut from that point. In Fig. 2 is shown a side view of the machine in operation. For widely different thicknesses of material the blades of the machine can be gibbed. New blades can be quickly inserted or old ones reground when necessary.

The unit is intended primarily for bench service. Four bolt holes are provided for use in securing the machine to the bench, or it can be fastened by ordinary C-clamps. The space required by the machine is 24x10 in. and its height is 20 in. The weight is 195 pounds.

"Niles" 48-in. Car Wheel Boring Machine

A heavy 48-in. car wheel boring machine with several added features has been brought out by the Niles-Bement-Pond Co., 111 Broadway, New York. The machine, shown in Fig. 1, is of massive construction with ample driving power. The features include an automatic chuck, a quick-acting crane, and greater convenience of control.

The table revolves in a bath of oil on a wide annular bearing. The automatic chuck is built into the table. It is self-centering, and closes automatically when the table begins to revolve. The heavier the cut, the greater becomes the gripping action of the jaws on the wheel. When the machine is stopped upon completion of the cut, the operator reverses the table drive and the jaws are automatically lossened. No wrenches are needed for tightening or loosening the jaws. The chuck has five hardened steel jaws, which are adjustable on slides fitted into radial slots. For setting the jaws conveniently, the table is scribed with circles from 26 in. to 43 in., which is the usual range of wheel diameters.

The construction of the chuck is as follows: Steel studs are set in the chuck jaw slides and carry on their projecting ends bronze cam blocks which fit in eccentric slots in a steel cam. The cam is a disk which fits into the chuck table and is confined by a ring. On the underside of the chuck cam, a lug projects down into a cored radial groove in the steel bevel driving gear. This groove is of such a length that it will allow the lug to rotate through an arc of 45 deg. After the wheel is placed in the chuck the main drive is started in the forward direction. When the table gear has turned through an arc of 45 deg. a hardened steel pin at the end of the radial groove on the upper side of the table gear strikes the lug in the cam. The rotation of the eccentric cam slots relative to the cam blocks draws in the cam blocks together with chuck jaw slides. Thus the wheel is automatically centered and the jaws grip the wheels rigidly.

The boring bar bearing is intended to resist wear under hard service, but is provided with a tapered bushing take up in case of any wear. The same design of take-up is also provided in the table spindle, to insure alignment of the boring bar and spindle throughout the life of the machine.

The crane for lifting the wheels on and off the table is located in a convenient position on the right-hand side of the machine. Its design is such as not to require extra headroom. The machine is furnished with either a pneumatic, or a motor driven drum-type of crane. The pneumatic crane can be controlled from the front of the machine. The drum-type crane is driven by a separate 5-hp. motor, and is controlled by friction clutches operated by a convenient lever. The crane has a long reach, which enables it to swing over two wheel supports, so that the finished wheel can be lowered at one point while the next wheel is ready to be picked up from the other support.

The machine feeds are positive through sliding gears and tooth

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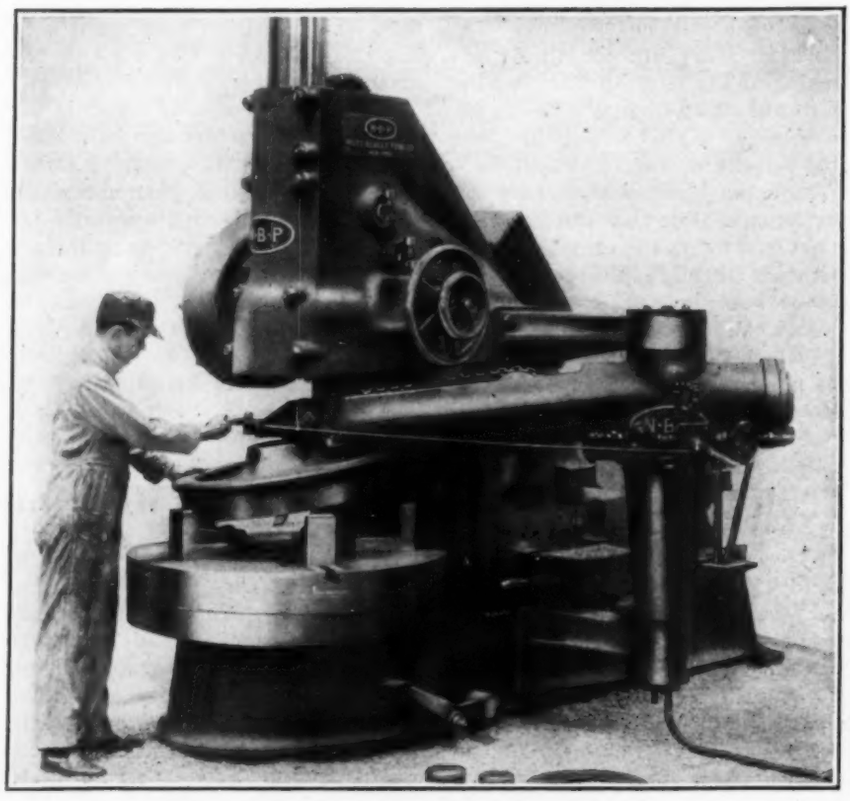

Fig. 1—"Niles" 48-in. Car Wheel Boring Machine

clutches inclosed in a feed box. A single four-position lever at the right hand of the operator gives the changes from roughing to finishing feeds. A compound gear reduction in the head allows the bar to be moved up with little effort by turning the handwheel. The boring bar has a counterweight running on rollers on an inclined way on the back of the frame.

When desired the boring bar is equipped with a power traverse, shown in Fig. 2, designed to save time and labor where a large number of wheels are handled daily. A ½-hp. motor on the left of the boring bar housing drives the feed mechanism through a large gear mounted on the feed friction. To raise the bar when the wheel is finished the operator simply pushes a button. A safety switch cuts out the motor automatically at the end of the bar travel.

A hub-facing attachment is furnished on special order. The hub-facing bar feeds outward from the center, and can be operated at the same time that the boring bar is feeding downward. The handwheels for controlling the traverse and the feed clutch of the facing bar are located on the operating side within easy reach of the operator. Four feeds of the facing bar are provided.

On belt driven machines, or machines fitted with a.c. motors, the table can be furnished with a pedal-controlled brake. On machines driven by d.c. motors the table stops by dynamic braking by simply pressing a button.

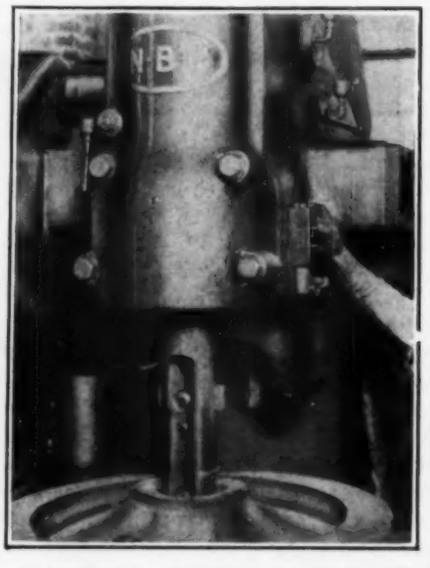

Fig. 2—Power Traverse for the Spindle

The capacity of the machine is claimed to be ample for wheels having the maximum A.R.A. standard length of hub, the boring bar having a travel of 39 in. When the bar is in the upper position, wheels having the maximum length of A.R.A. hubs can be swung into position without interfering with the chuck jaws or the tool bar.

Pamphlets Received

Pattern Color Chart. The American Foundrymen's Association, 140 South Dearborn St., Chicago, Ill., has published a pattern color chart showing a sample pattern painted according to the standards adopted by the joint committee on pattern equipment standardization, in 1925.

United States Government Master Specifications for Pneumatic Hose. Circular of the Bureau of Standards, No. 307, published by the Department of Commerce, Washington, D. C. This circular gives the general specifications and requirements as to materials and workmanship for pneumatic hose. The methods for inspection and tests and for packing and marking are also outlined.

Trade Catalogs

Welding Rods. The Chicago Steel & Wire Co., 103rd St. and Torrence Ave., Chicago, Ill., has added to its list of publications on welding rod a booklet entitled, "The effect of Surface Materials on Steel Welding Rods." This booklet, prepared by the research department of the company supplements a previous pamphlet entitled, "Fusion Welding."

The booklet is not advertising in character but is devoted to a non-technical discussion of the effect of working qualities of metallic and non-metallic surface materials. The booklet describes the effect of surface materials from the standpoint of some of the scientific laws governing the metallic arc and gives suggestions regarding the proper surface materials for gas and electric filler rod which will be found useful by operators.

A catalog of "Weldite" welding rod is also given at the back of the booklet.

Wood-Screw Machines. The Asa S. Cook Co., Hartford, Conn., has issued circulars describing its automatic pointing machine, open die header, shaver and slotter, and threader and pointer for the manufacture of wood screws.

News of the Week

Steel Treaters Will Extend Activities to Include Non-Ferrous Metals

Spring meeting at Hartford last week drew large crowd

What was stated to be one of the largest gatherings of technical men on record in New England assembled at the Hotel Bond, Hartford, Conn., May 20 and 21 to attend the sessions of the spring sectional meeting of the American Society for Steel Treating. The reading of the papers was well attended, and 331 members and guests sat down to the banquet of the society on Thursday evening.

More than half of the attendance at the sessions consisted of non-members of the society, showing the intense interest existing in the subjects discussed. The papers read at the sessions were: "Factors Affecting the Machinability of Alloy Steel," by J. S. Vanick, the International Nickel Co.; "Necessary Precautions in the Manufacture of Alloy Steels," by Marcus A. Grossman, the United Alloy Steel Co., Canton, Ohio; "Recrystallization Temperatures of Cold-rolled Electrolytic Iron and Open-hearth Strip Steel," by John R. Freeman, Jr., of the Bureau of Standards, Washington; "Forging by the Upset Process," by J. C. Kielman, the New Departure Manufacturing Co.; "The Role of Stainless Iron and Steel in Industry," by Norman L. Mochel, the Westinghouse Electric and Manufacturing Co.; "Heat Treatment of Die Blocks," by Alfred J. Porter, Jr., the Heppenstall Forge Co.

Samuel M. Stone, president of the Colts Patent Fire Arm Manufacturing Co., presided at the banquet on Thursday night. The principal speakers of the evening were Robert M. Bird, national president, A.S.S.T., Edwin P. Root, president, the New Haven Clock Co., and Frederick G. Hughes, vice-president, the New Departure Manufacturing Co. Mr. Bird, in speaking on the objects of the society, declared that it was the intention to extend activities to include the non-ferrous metals as well as steel and its alloys. He said that the society would not lessen any of its work in connection with research into the characteristics and treatment of steels, but that the non-ferrous metals were so greatly associated with the ferrous in the machinery industry that the study of the two classes must also be associated.

Mr. Root, who has been for fifty years associated with the New Haven Clock Co., took as his subject "The Romance of Manufacturing." He recalled some of the early inventions and inventors in New England industries. He pointed out how the present investigations into the structures of steels are as wonderful in their field as the early discoveries in medicine by the inventors of the microscope. Mr. Hughes devoted a part of his talk to the subject of obsolescence, and declared that there was a movement now in progress among New England Manufacturers to shake off some of the ultra-conservatism, and by new machinery, improved processes, and through technically trained men to meet the competition of the West.

The afternoons during the session were devoted to visiting manufacturing plants in Hartford and neighboring cities. Among those visited were: Colt's Armory, Billings & Spencer Co., Pratt & Whitney Manufacturing Co., Royal Typewriter Co., Union Drawn Steel Co., Underwood Typewriter Co., International Silver Co., Meriden, and the New Departure Manufacturing Co., at Bristol. More than a hundred members spent Friday afternoon at the latter plant.

The paper presented at the Friday evening session by Norman L. Mochel, on the subject of stainless steels was especially interesting from the standpoint of the heat-treater. Mr. Mochel discussed the characteristics of low-carbon chromium-iron alloys and their structural action under varying heat-treatments, and illustrated his talk with numerous slides showing microscopic views of the steels under different heating and quenching conditions.

In his paper on recrystallization, Mr. Freeman gave the results of studies made on selected steel strips for deep-drawing operations. It was demonstrated that electrolytic iron underwent a recrystallization and decrease in tensile strength with increased annealing temperatures up to 930 deg. F. At 1,200 deg. F. the tensile strength was approximately the same for all specimens, the amount of cold work previous to annealing having no influence.

Would Reduce Waste in Metal Trades

A definite program of procedure for the co-ordination of efforts of various technical, scientific, trade and other organizations for a more effective elimination of waste in the metal trades was adopted at a conference on May 13 under the auspices of the Department of Commerce. As the first step, formation of the National Committee on Metals Utilization was effected to supervise the elimination of waste progress in co-operation with the Department of Commerce.

At the opening of the conference, Secretary of Commerce Hoover presided and spoke on the merits of the work to be undertaken. W. C. Wetherill, Director of Metals Utilization of the department, outlined to the conference the achievements so far in simplification of trade practices.

R. M. Hudson, chief of the department's Division of Simplified Practice, spoke of the achievements to date in reduction of variety and dimensions in the elimination of waste.

Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce of the department, discussed the elimination of waste in foreign trade.

Judge Gary on Labor Problems

In his annual address to the members of the American Iron and Steel Institute, gathered at the twenty-ninth general meeting of that body, Elbert H. Gary, chairman of the United States Steel Corporation, devoted the greated part of his remarks to a discussion of labor problems. His text was based in substance on the recent general strike in England, and Mr. Gary spoke at some length on labor conditions in this country.

After a brief introduction to the subject, Judge Gary said:

"We rejoice that the opposing interests seem to have emerged from what appeared to be conditions approaching serious controversy without leaving any unhealed or incurable wounds or bitterness. We congratulate all who participated in bringing this about. The whole world is akin, and whatever severely hurts one part to a greater or lesser extent is felt in the other parts. This is especially true of Great Britain and the United States.

"No important dispute between different interests, national or international, can be finally settled unless the conclusion is both righteous and logical. Perhaps if it is either, it is necessarily both. This point might be elaborated. It is sufficient at present to say that we believe if any decision is actually right and just, it is logical, and *vice versa*. Also, to secure and insure both, the results and the means of approach must be in accordance with the principles and precepts of law and order; otherwise the embers of discord and dissatisfaction will slumber and sometime, sooner or later, will likely kindle and flame for future and further trouble.

"According to the public prints, it has recently been stated by a leading, and, as I believe, an intelligent labor leader and very good citizen, that many of the employers of this country will

not permit collective bargaining in behalf of employees. This statement is not strictly accurate, unless it was intended to say only that certain employers refuse to participate in negotiations for labor conditions and terms with men claiming to speak for groups of workmen they do not really represent.

"Men have the right to act collectively. No employer can or should attempt to prevent this so long as all laws are complied with, otherwise than by withholding employment or by discontinuance of operations. This the employers have the right to do, so long as they observe all the provisions of the laws."

Switching his thoughts to business, Mr. Gary said in part: "The basic industrial conditions of this country at the present time, taking into account all that could be truthfully said for and against, are very much better than on the average, and on the whole about as good as they have ever been, perhaps better.

"We are at peace with all the nations of the globe, and this is likely to continue. Labor conditions are generally peaceful and quiet. The intention and effort of employers towards employees are considerate and just. The same may be said of employees toward employers. Money is plentiful, the per capita circulation is very large, interest rates are low, and every responsible, worthy applicant finds no difficulty in obtaining funds for legitimate enterprise. The banks are strong and well managed, the bankers are fair and acommodating and have the full confidence of the general public. The people are at work; they are disposed to economize; they are, in the main, sober and law-abiding, and not inclined towards extravagance, although there are striking exceptions manifested in some localities. As a rule, wages are fair and reasonable, though in certain lines are outrageously high. The law of supply and demand will sooner or later bring these matters to a just and proper regulation."

The meeting was divided into two sessions, morning and afternoon, and was held at the Hotel Commodore on Friday, May 21. Other speakers on the program included: D. L. Galusha, of the Dwight P. Robinson Co.; A. N. Diehl, vice-president of the Carnegie Steel Co.; H. S. Rawdon and Samuel Epstein, of the Bureau of Standards; S. J. Cort, of the Bethlehem Steel Co.; W. A. Haven, of the Republic Iron and Steel Co.; and A. E. Lindau, of the American System of Reinforcing. The annual banquet was held in the evening at which the addresses were extemporaneous. James A. Farrell was the toastmaster.

Machinery Manufacturers and Dealers Hold Combined Convention

Take further steps to secure modification of anti-trust laws—Cost systems and sales problems receive attention

An outstanding feature of the combined annual convention of the Southern Supply and Machinery Dealers' Association, and the American Supply and Machinery Manufacturers' Association, held in the Statler Hotel, St. Louis, May 18, 19 and 20, was the strong measures adopted to take the necessary steps to have Congress bring about a modification of the Sherman Act so that business could be developed on a broader basis. Important problems were satisfactorily presented and an expression of satisfaction was made by the officers and members of both associations.

Newly-elected officers of the Southern association are: President, L. J. Larzelere, the Farquhar Machinery Co.; vice-president, T. C. Keeling, the Nashville Machine and Supply Co.; second vice-president, F. M. Archer, the Superior Supply Co.; secretary-treasurer, Alvin M. Smith, the Smith-Courtney Co. The executive committee is: Chairman, George Winship, the Fulton Supply Co.; J. L. Pitts, the Brown-Roberts Hardware and Supply Co., Ltd.; C. C. Rose, the Central Supply Co. and W. W. Doe, the Alabama Machinery and Supply Company.

The following officers were elected by the American Association: President, D. S. Brisbin, the Columbus-McKinnon Chain Co.; vice-president, R. B. Skinner, the Skinner Chuck Co.; second vice-president, A. R. Webber, the H. B. Sherman Manufacturing Co.; third vice-president, J. H. Williams, J. H. Williams & Co.; secretary-treasurer, F. D. Mitchell. The executive committee comprises: Chairman, W. C. Henning, the A. Leschen & Sons Rope Co.; C. O. Drayton, the Graton & Knight Manufacturing Co.; Horace Armstrong, Armstrong Bros. Tool Co.; W. H. Glatt, the Victor Balati Co.; W. F. Wright, the Wright Manufacturing Company.

The Southern Supply and Machinery Dealers' Association passed a resolution designed to assist and help the mill-supply industry to function better by giving better service and, at the same time, enable the owners to make a fair profit on their investment. Such points as the determination of costs through proper cost-finding systems; maintenance of prices that are fixed: the jobber going out of his natural bounds to increase the value of his business; carrying out the golden rule in business, recognizing competition; working out a satisfactory territorial credit arrangement; carrying stocks that will supply the reasonable demands and turnover six times a year—were passed.

The American Supply and Machinery Manufacturers' Association stressed the folly of cost cutting and recommended its elimination for better business. A year ago this association appointed a special committee headed by D. C. Williams to take up with the more than 500 organized-trade bodies in the United States a proposition of holding a meeting at some central point to consider the means of bringing forcibly to the attention of Congress the necessity of amending the Sherman Act and other so-called anti-trust laws. Several of these bodies have replied to suggestions sent out, and a resolution was passed that the executive committee assist the special committee in every way possible to accomplish its purpose of uniting these trade associations in a concrete body for that definite purpose, and that such reasonable expenditures of money as may be needed to bring this condition about be used.

Combined meetings of the associations were held in the afternoons of the three days while morning sessions, held individually, were devoted to the purpose of transacting miscellaneous business, discussion of annual reports, nominating of committees and other executive functions.

The first joint meeting, at which N. A. Gladding, of E. C. Atkins & Co., Inc., presided, was opened with an address by Hon. Victor J. Miller, mayor of St. Louis, who welcomed the members of the associations to the city.

Shopping Economy

Kirke H. Taylor, general purchasing agent, the Illinois Glass Co., and vice-president of the National Association of Purchasing Agents, Inc., read a paper, "Is It Economical Purchasing for a Large Corporation to Go Shopping Around?" Mr. Taylor brought out several factors relative to the purchase of materials and emphasized the importance of transacting business with the manufacturer that gives full value for money spent. He said that in the purchase of materials on a large scale or for continuous consumption, and in the investment of money in machinery, not only is it economy but wisdom to cover thoroughly all sources of supply. Make a practice of placing your business at cut prices and you aid and abet the chronic disturber of business. No manufacturer can maintain the standard he should in the face of persistently cut prices.

Further points discussed were the various types of buyers a salesman has to deal with, and the necessity of building up friendships with those from whom you buy as you do with those to whom you sell, so the desirability of "shopping around" will be limited to known and reliable sources where the price, the goods and the service will be to your advantage.

"Commercial Sportsmanship," by Lucien M. Harris, financial editor, the *St. Louis Globe Democrat*, followed. Mr. Harris told several anecdotes to illustrate the subject and agreed with the definition of one of the country's large bankers that commercial sportsmanship was not "shooting birds on the ground." He offered some practical suggestions obligatory in the control of business.

D. R. Burr, of the Goodyear Tire and Rubber Co., presided as chairman of the second session in which the first paper dealing with the practice of some manufacturers to allot more tonnage to a dealer than his necessary stock requirements, resulting in demoralization of market when unloading surplus, was read by John F. Hazen, of the Pittsburgh Steel Co. The topic dealt with

the harm that results when a manufacturer induces a dealer to accept excessive stocks. Mr. Hazen stressed the point that business can be built and expanded soundly only by sane methods.

The final paper, "Odd-Sized Material," was presented by S. A. Ellicson, of the Chicago Pulley and Shafting Co., with a further discussion by J. L. Pitts, of the Brown-Roberts Hardware and Supply Co. The subject covered the problems connected with the marketing of slow-moving stock, and the additional cost required in handling such material. It was suggested that the simplification program of Secretary Herbert Hoover be followed as far as possible.

The second meeting was presided over by George W. Lemaux, of the Indianapolis Brush and Broom Manufacturing Co. Mr. Winship brought out the relationship of the distributors and manufacturers by comparing them as a partnership in which each partner should look after the other's interests by treating him fairly. The various types of manufacturers were discussed, those who sell direct to the consumer, those who sell entirely through the distributor and those who have one policy in one territory and another policy in others.

Buying and Turnover

"Hand-to-mouth buying," was discussed by Henry G. McComb in the absence of the author, David C. Jones, of the Lunkenheimer Co. It dealt on the stocks that should be maintained and the service that should be rendered by the jobber to his customers. A further discussion of the subject by D. D. Peden, of the Peden Iron and Steel Co., gave examples of stock turnover, and quantities in which merchandise should be maintained in accordance with the conditions of the territory. Emphasis was stressed on the importance of simplification and standardization of materials that would make possible the elimination of special orders and the handling of slow-moving stocks.

Dixon C. Williams was chairman of the second session and the first paper, "Specialty Salesmanship," by K. G. Merrill, of the M. B. Skinner Co., was read. Mr. Merrill brought out the advantages of specialties in that they built up a reputation for the salesman through the interest he creates in the buyers. The paper mentioned that specialties make profits, create new accounts, hold old accounts, improve the ability of salesmen, and hold the good will of the jobber.

An open discussion, "Maintaining Suggested Resale Prices," followed. Mention was made that the jobber should stick to the resale price recommended by the manufacturer, and a resale price should be established to offer a fair margin of profit for the manufacturer and the jobber.

Immediately following the separate sessions of both associations was held the final joint meeting. Newly elected officers of both associations were introduced. A paper, "Need of a Uniform Contract," was read by T. F. Bailey, of the Banks Mill Supply Co., in which it was mentioned that manufacturers use different forms of contract that contain clauses of uncertain meaning. The importance of a standard form was brought out, and a prepared and recommended form, such as used by the Associated Equipment Distributors, was given to the members for reference.

"Elimination of Waste in Mill-supply Distribution from the Outsider's Viewpoint," was presented by Merrit Lum, publisher of *System* and *Industrial Merchandising*, in which waste was blamed on traditional thinking.

The last paper was "Dealer or Curbstone Broker," by J. B. Crimmins, of the Mill & Lupton Supply Co. Unfair methods by the manufacturer were covered, and the importance of a sound understanding between the dealer and manufacturer was emphasized.

W. C. Henning, chairman of the entertainment committee provided a well-balanced program for the ladies and diversion for the members.

Conference Board Elects L. A. Osborne Chairman

Owen D. Young, principal speaker at the tenth annual dinner of the National Industrial Conference Board at the Hotel Astor on May 20, suggested a change of policy on the part of the Government in its investigations of industries. Instead of inquiring into the affairs of those corporations that show profits, Mr. Young recommended investigation of those which are not profitable, and therefore, in Mr. Young's opinion. of no service to society.

"Industry," said the speaker, "should be profitable. I have no sympathy with indictments of profits. They are the motive power of our economic system and why deny it or apologize for it? I said in Washington, in the presence of the President some months ago, that I thought it would be a good idea if the Government would change its policy. I had noticed for a number of years that whatever investigation was to be made, it was of the concern that made some profit. It was the only one that the Government took any interest in."

Magnus W. Alexander, president of the board, read letters from Secretaries Mellon, Hoover and James J. Davis, as well as European bankers and industrialists, congratulating the organization on its work.

Lessened Domination

Speaking at the annual meeting in the afternoon, Frederick P. Fish, chairman of the board, emphasized particularly the better relations existing between employers and employees, although admitting that there was still some danger of workers' organizations attempting to dominate business management. Clear vision, intelligence and goodwill, he declared, were shown today by business men as never before in the history of industry.

Mr. Fish, who has been chairman of the board for ten years, resigned this year. He was elected honorary chairman at the meeting last week. He is succeeded by Loyall A. Osborne, president of the Westinghouse Electric International Co. Charles Cheney, president of Cheney Brothers, South Manchester, Conn., a former member of the executive committee of the board, was elected vice-chairman.

Air Commerce Bill Gives Control to Hoover

As agreed to in conference the Air Commerce Bill requires the registration of aircraft engaged in the interstate transportation of persons or property for hire; in the furtherance of a business and in the operation of a business.

By the furtherance of a business is meant such operation as the transportation by air of factory products from the main plant to a branch office, or the use of aircraft by professional men while traveling on business. By operation of a business is meant such activity as the "gypsy" flier who goes from place to place giving exhibitions.

Aircraft are eligible for registration only when owned by a citizen of the United States. If the owner is a corporation fifty-one per cent of the voting stock must be owned in this country.

The Secretary of Commerce is required to provide for the examination and rating of registered aircraft as to their airworthiness. Examination of aviators also is provided.

The Secretary of Commerce also is empowered to establish air traffic rules for the navigation, protection and identification of all aircraft. These regulations are to apply to non-commercial flying.

Ford Air Service Makes First Year Record

On April 13 the Ford air transport service completed its first year of activity. During the full year of operation the number of trips made mounted to more than a thousand, the distance covered to more than 220,000 miles—at a rate of 100 miles an hour—and the freight carried to 1,044,402 lb. The *Maiden Dearborn I*, first unit in service, made 302 trips over a distance of 68,632 miles carrying 298,008 lb. of freight, during the year.

In the entire year of activity not a single accident occurred which could be laid to failure on the part of the plane, and no one was injured. The design with which the service was begun proved so nearly satisfactory that the planes are today virtually the same in construction as when the first line was opened.

Of the 663 trips begun over the Chicago route during the year, 649 were completed, giving an efficiency rating of more than 97 per cent. In the course of these trips, Ford planes covered 165,495 miles and carried 635,221 lb. of freight.

The efficiency record of the Cleveland line is even better. Of 457 trips started on this line, 453 were completed as planned, making the line's efficiency better than 99 per cent. Over this route the Ford all-metal planes carried 409,181 lb. of freight a distance of 57,531 miles.

The problem of mechanical failure will virtually be solved by the introduction of multi-motored planes, each driven by three air-cooled engines. The triple allowance of motors will give a plane ample power to continue even if one motor is stopped, and plenty of power with which to maneuver for a landing even if two motors are stopped.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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STABILIZATION is a much overworked word nowadays. It is used to describe the maintenance of a non-changing price level. Before stabilization was achieved it was thought to be desirable. But "man never is but always to be blest," and some are now complaining because the markets have almost ceased to fluctuate. There is no excitement; speculation is dead, and many interpret the resulting dullness as indicating the approach or arrival of a business depression. This interpretation is not warranted but Americans have become so accustomed to the plus sign that they think they must be going backward if their records do not register expansion.

Therefore it often happens that quietude breeds pessimism and this may partially explain the predictions of lower prices and trade contraction that are to be heard from those who are usually optimistic. It may also explain the susceptibility of the markets to bad news and the willingness to construe what is advertised as the "first pre-inventory sale" ever held by H. B. Claflins, Inc. as an evidence of stagnation in the dry goods trade.

The deflation that followed Wanamaker's bargain sale in 1920 is still remembered and it is about as difficult to persuade business men that a decline in prices will clear the atmosphere as it is to convince a child that a spanking is good for him.

But explain it as we may it is nevertheless true that the prevailing mood is one of doubt and that the news is being read through blue glasses. Hence emphasis is laid upon reports that indicate some decrease in the building permits issued in April, the curtailment in cotton manufacturing, a diminishing demand for steel, lumber and cement and some price cutting in the automobile trade where distributors are said to be selling new cars in exchange for old ones plus very little cash.

Recent political developments have also had some effect. The Pennsylvania primary brings the prohibition question well to the front and an entirely new Congressional alignment is predicted if the referendum to be held in the State of New York shall further advance the "wet" cause.

Then there is the foreign situation. The British strike is practically settled and with Sterling at over the gold parity of 4.8666 England seems to have turned the corner. But predictions of prosperity in Great Britain are met with the statement that keener competition between America and England will follow and that we will have to accept lower prices for what we produce.

The decline in the value of the French franc and the sympathetic depreciation in Belgian francs and Italian lire are also seen as factors that will bring about lower prices in this country because they will restrict the purchasing power of continental Europe. This is probably true and the French seem to be so hysterical over the prospect that they are powerless to avert what amounts to a national default.

But it is a condition that has threatened for a long time and in so far as this country is concerned it is better that it should be behind us rather than ahead of us.

The same thing may be said of the decline in the price level that is so generally expected here. "If it were done, then 'twere well it was done quickly," but it is at least questionable whether we shall get any further decline in our agricultural products and as the chief grievance of the farmers is the relatively high cost of manufactured articles, a readjustment of the disparity will not be accepted as an unmixed evil.

Corn and the wheat that is now maturing are both selling at less than the alleged cost of production and a further decline seems doubtful. New crop cotton is at or near the lowest price in five years and it seems difficult to depress it further.

Sugar is distinctly steadier. At about 47 cents, rubber is nearing the price of 42 cents at which the Stevenson Plan for restricting exports will again become operative and the Brazilian Government is irretrievably committed to the maintenance of the coffee market at present prices.

In none of these major staples is there any speculative distention; nor anything that fore-shadows lower prices. There is an abundance of credit and work for everyone at good wages. The so-called fundamentals are sound and the ghost of lower prices in the industrial field seems to be the chief cause of the cautionary spirit that is abroad. Perhaps it will pass but competition is the life of trade and it is quite possible that we may be benefitted by competition that will compel us to work harder and figure closer on future business.

But self-discipline does not promote hilarity and no effervescent activity is to be expected until something happens to change the psychology of the markets. The prevailing lethargy is reflected on the Stock Exchange. Speculation is dull but the ease of money is sustaining the bond market and is likely to prevent any serious decline in stocks, an event always taken seriously by business people everywhere.

What's Doing in Industry

When orders are easy to get we have a habit of describing the situation as a "seller's market." According to that reasoning, the present situation in the machinery and machine tool market may be characterized as a "buyer's market." Business is to be had in fair volume by those who go after it. Inquiry mail has dropped off and large orders from industrials are conspicuous by their absence, but the volume of orders for single tools for replacement, or for increasing production, is holding up to expectations.

The market in Detroit is beginning to show signs of better conditions, recent announcements of expansions by automobile manufacturers promising large orders for new machines. Chicago is busy on old inquiries, but new business is slow in closing. Inquiry in the Cincinnati market is good, but buying has been somewhat curtailed in the past ten days.

The month of May shows a slight improvement in business in the Cleveland district, and Milwaukee reports more activity following a dull period of several weeks.

Slight improvement is noted in New York, but Philadelphia sales and inquiries have dropped off considerably. Buffalo reports little change, with orders below estimates. The New England territory again reports increased demand for special automatic machines with the volume of new inquiries keeping business at a satisfactory level.

The oft heard prediction that a dull period in business indicates the arrival of a depression is unwarranted. Americans have become so accustomed to the plus sign that they think they must be going backward if their records do not register expansion.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Cincinnati

The Cincinnati machine tool market was not very lively in the past week. There were plenty of inquiries from all sections of the country, but the orders forthcoming were not in proportion to the indicated needs of machine tool users.

Manufacturers and selling agents regard this as nothing more than a temporary lull, and they expect the sales curve to take an upward course in a very short time. There has been no curtailment of manufacture, as orders on hand are keeping factories busy.

The greater part of the week's business consisted of orders for single tools, for replacement purposes. These came from various kinds of machine tool users, were well distributed over the different sections of the country, and were well diversified as to sizes and types of tools.

Some single tools were sold to the automotive industry, and it is thought that the demand from this field will soon show a large increase. Railroads ordered a few single tools.

Buffalo

Little or no change is to be noted during the last fortnight in the machine tool and allied trades in Buffalo. Some dealers who expected a falling off of business in the last part of May have been agreeably mistaken in their expectations.

There is a noticeable slackening, however, in the sales of the ordinary run of machine tools. With some exceptions dealers report a falling off in the number of inquiries.

On the other hand those dealers and manufacturers who are dealing in electrical equipment report that business is holding up well and that inquiries are maintaining an even volume.

The demand for contractors' equipment is constantly improving and indications are that there will be a big season in the sale of this equipment, not only for the use of road contractors but also building contractors.

Detroit

The outstanding event of the past week in machinery and machine tool circles in Detroit was the announcement that the Chevrolet Motor Co. will expend approximately ten million dollars to increase production to a peak capacity of 1,000,000 automobiles.

According to W. S. Knudson, president and general manager of the company, building plans under the new program have been completed and some of the machinery already ordered. Installation of the improved machinery will cost approximately $6,000,000, while $4,000,000 will be expended in making additions to the company's plants throughout the United States.

This is the only program of outstanding size now under way in the motor car plants in Michigan. Most manufacturers are buying small stuff, but many others are holding up orders. Such machinery as is being placed is a general line of equipment, milling machines, lapping machines, lathes, borers, etc. Competition remains keen with every dealer bidding for every bit of business in sight.

Some machinery will be purchased for the plant of the Stinson Airplane Corporation, at Northville, as officers hope to have production under way within a few weeks. Very little machinery is being ordered for the Highland Park and the Fordson plants.

The Saginaw City Commission at Saginaw, Mich., is in the market for electrically operated machinery for the new water works pumping station.

An addition to the pattern and repair department of the Atlas Drop Forge plant at Lansing, Mich., is under way, which will entail the expenditure of several thousand dollars for new machinery.

Chicago

During the last week business in machine tools has shown no material improvement. While an occasional sale involving a good profit is reported, the average of sales is small by comparison with two months ago. Salesmen in some of the Middle-West states are turning in fairly good orders to Chicago headquarters.

A recent report by one of the Illinois state departments having to do with manufacturing industries of the state, indicates that there has been a general slowing up in factory production, a fact which machinery men interpret as having some bearing on present inactivity in the machine tool market. Chicago representatives of Eastern manufacturers of machinery seem not to have felt the general reaction.

With the exception of the closing of a list of tools required by the International Harvester Co. for the new Rock Island shop, none of the large buyers has recently come into the market except for an occasional tool. Railroads have not yet indicated that they are ready to close outstanding lists,

Milwaukee

Comment on the situation in the metal-working equipment market generally agrees on the fact that business is improving slowly after a brief period of slackening tendencies. It is certain that buyers are exercising caution in meeting their requirements, and awaiting more definite trends before placing orders for equipment other than that made absolutely necessary by ordinary shop needs.

Meanwhile there are numerous instances coming to light of shops that need more capacity and are not hesitating to acquire new equipment. This buying forms a moderate aggregate which is sufficient to enable the tool manufacturing trade to sustain production without material decline from the average of recent months. On the other hand, some of the interests which have been steady buyers for a long time past are proceeding with conservatism.

Cleveland

The first three weeks of May have brought an improvement in sales of machinery and machine tools. This activity comes as a welcome relief after a brief dull period. Although sales were mostly for small pieces, the aggregate total showed a satisfactory increase. The largest buyers were automobile accessory and metal-working concerns.

Combined with the recent upward trend and the new business in prospect it is the general opinion of the trade that business will continue on an even basis for the next two months.

Cancellation of the local building strike is expected to have a tendency to increase machine tool sales, as several local firms have announced plans for expansions along industrial lines.

New England

Milling machines, multiple-spindle drilling machines and a wide variety of special automatic production machines are in demand for immediate shipment and there is a better tone to inquiries now being received in the New England territory. These inquiries are originating in the automotive field, and also in the radio industry.

Special machinery builders have offers for contracts for the building of special machines, but, in general, are unable to accept the business because of the orders already in hand. Hand tool manufacturers are busy. Taken as a whole machinery business is "good."

With the amount of business on hand manufacturers are ready to employ all skilled mechanics presenting themselves. Employment continues to expand. There is said to be a shortage of highly skilled machinists.

Philadelphia

Business among machinery and machine tool producers in the Philadelphia area does not present a hopeful aspect at this time. Inquiries coming to the sales offices of some of the dealers have not been satisfactory, and there was little upon which hope for a busy summer season could be based, officials said.

Uncertainty prevailed among most dealers, especially those dealing in tools for locomotive repairs. A few inquiries have been received for specifications, but these have been spasmodic, coming from an area scattered among the Eastern states.

Dealers in small tools find the late spring retarding their business. A considerable amount of this business comes from the Northwest and from New England, and salesmen have had some difficulty in reaching the trade. The small tool business has not been holding up as well as the first part of the year seemed to indicate it would.

New York

A more intensive sales effort on the part of local dealers and agents has brought about a better condition in this market in the past ten days. It is the general belief that there is business to be had for those who would go and get it. Inquiry mail has slackened off and quotations are slow in bringing orders, so the market has developed a situation that calls for persistent personal effort on the part of the seller.

Railroads have placed several orders but these have in each case been for single pieces. A few orders are on record from automotive sources, Packard, Oakland and Ford being included. The Wabash, Southern Pacific and the Peoria & Eastern are mentioned among railroad buyers.

The used tool market still faces a condition where high prices and a shortage of good material combine to make it a buyer's market.

Germany to Solve Cost Problems by Adoption of American Production Methods

Failure of supposed German perfection in manufacturing leads to study of our system of mass production

BY OUR BERLIN CORRESPONDENT

For more than a year business in Germany has been in a state of depression hardly ever experienced before, and most acutely accentuated after the hothouse activity of inflation times.

When manufacturers are asked for the reasons, the reply is invariably:

"Our prices are too high, our domestic market has not sufficient purchasing power, and in foreign markets we are more or less out of competition."

This is "Kismet" to the majority of manufacturers, something unavoidable, brought about by circumstances beyond their control.

The reasons given for the high level of prices are usually the following: taxation, high social burdens (for the welfare of employees), scarcity of money and consequent prohibitive interest on credit. Up till recently a further reason was added—the slackness of workmen. Such complaints have almost disappeared; manufacturers seem satisfied with the efficiency of their labor.

Few of the responsible men in the midst of things have gone very deep into the matter, but those a little farther away, viewing the manufacturing process more objectively have turned their analytical minds on the cost problem, which as the slump continued has become keener and keener. At present the cost problem in German industry has assumed national importance and is beginning to move all circles governing public life. It is the most prominent problem of the present day.

A SHATTERED ILLUSION

About two and one-half years ago, shortly after the end of the Ruhr occupation, German industry of post-war times entered into a new era. The so-called revolutionary labor conditions were abolished and pre-war conditions almost restored. A good deal was expected from this remedy. The far-reaching hopes were, however, disappointing to a large degree. During the same time another illusion was shattered, one lurking in the minds of many manufacturers, that of the acme of perfection prevailing in their establishments and in German industry as a whole.

After the failure in the remodeling of labor conditions and the recognition that German industry is not up-to-date, as was generally believed, the road was open to closer investigation into the causes of apparent ailments, and it was, of course, quite natural that this road pointed to the United States. With every motor car that came from America, manufactured there at considerable higher cost of labor and in spite of high duty sold in Germany cheaper than German cars, the question became more pressing.

The immediate consequence was that many men of importance in German industry, including a great number of manufacturers, went on a tour of inspection to the United States and came back elated at what they had seen. What crystalized therefrom was the plan to "Americanize" German manufacturing processes.

This movement soon entered its first stage, and passed it rather quickly. It must be said that this first stage brought another disappointment, the recognition that the mere adoption of American methods, especially those on the Ford plan of manufacturing, is not suitable to the size of the market which German industry can command. Incidentally, however, this first stage brought a keen revival of the interest in American machine tools as is clearly demonstrated by the import figures of last year. The movement is now at the beginning of its second stage which may be defined as an adaptation of American working methods to the different conditions under which German industry operates.

CREDIT IS STIFLED

The ailments from which German industry at present suffers, and which are the key to the curious fact that Germany with her comparatively cheap labor and far advanced industry is faced by a serious cost problem, may be briefly described as follows: There is a scarcity of working capital in conjunction with the large interest on loans and this impedes the supply on credit terms and thereby checks the demand and obstructs radical and extensive plans for remodeling the manufacturing process.

This fact is obviously and clearly recognized everywhere. Such is not the case with another fact which may be considered one of the chief roots of the German cost problem—the "trustification" of German industry.

Never in the history of industry was there an example of such complete syndication as exists at present in German industry, from the highest down to the simplest classes of trade. Every producing business is organized in a group, society, association, or whatever it is called, and receives its price policy from the directors of its organization. This price policy varies from loose so-called directions with regard to prices (Richtlinien hinsichtlich Preisen) to strict rules whose observation is secured by penalties. As a consequence free competition is almost eliminated and the level of prices established at arbitrary methods based upon the principle that the last straggler has to have a chance to exist.

This state of affairs is almost as ruinous to German business as the much complained of turnover tax, one of the many parts of the ramified taxation system, and which as it is levied on every article passing from one hand into the other is largely antagonistic to a highly specialized manufacturing system. The turnover tax is justly described as the third, and certainly as one of the chief evils underlying the cost problem, as can be seen when considering that it subjects articles of a highly finished state sometimes to a taxation up to 20 per cent of the sales price.

The problem now faced by German industry is how to overcome these three factors which must be regarded as stationary features. The credit situation has lately been somewhat alleviated, but the govrnment cannot spare the turnover tax which is one of the pillars of the state budget, and as regards the nuisance of concerted price policy, the German authorities have several times tried to break it, without result. Dire need will perhaps have a better effect but it can hardly be hoped that a system so deeply rooted in present day conditions as well as in German mentality can easily be removed.

As matters stand, the solution of the cost problem is seen in the rationalization, as it is termed in Germany, of working methods — meaning the achievement of greatest economy in production accomplished by a modified American process of mass production with parallel progress in the direction of specialization and standardization. The spirit of individualism so long adhered to is the first to be attacked, a movement mourned by German manufacturers but nevertheless recognized as unavoidable.

American industry is the model underlying the plan, and this is a fact which will doubtless react strongly on the importation of such products required for shaping the German working process according to the American plan, with modifications solely in respect to limitation of quantities. The speeding up process is now the problem in German industry calling the attention of all responsible men in industry and government and will doubtless be vigorously pursued.

Metal Trades Will Prepare Foreman Textbook

At a meeting of the educational committee of the National Metal Trades Association in Springfield, Mass., May 14, it was decided to prepare a textbook for prospective foremen in the metal trades, after the example of textbooks already introduced for apprenticeship courses in these trades. Robert Spence of the Springfield Technical High School, who collaborated in preparing the textbooks for apprentices, will write the foremanship textbook.

A large part of the time at the Springfield meeting was devoted to a discussion of the outlines of the new foremanship course. Directors of various technical and vocational schools in the Connecticut Valley attended the meeting, and spoke on different angles of the subject. Speakers representative of the association and various metal industries included: John C. Spence, Norton Co., Worcester, chairman of the association committee on industrial training; Homer D. Sayre, national commissioner of the association; J. E. Nyhan, national secretary.

News of the Automotive Industry

Twenty-five million automobiles are now in operation throughout the world. The detailed reports from more than 130 countries and major territorial divisions reveal the use of 24,452,267 cars and trucks, together with 1,459,668 motorcycles.

This huge total not only far exceeds that of any previous year, but it likewise shows that the increase in 1925 was at the highest rate in the history of the automotive industry.

While many motors are built in foreign countries, exports of Americna made cars are increasing rapidly. It is predicted that one million American automobiles will be exported in the year 1928.

Expenditure of $10,000,000 and increased production to peak capacity of 1,000,000 automobiles annually, will be made by the Chevrolet Motor Co. during the year beginning June 1, 1926, it was announced last week by W. S. Knudson, president and general manager of the company.

Building plans under the new program have been completed and machinery ordered. It is expected the new record production will begin Jan. 1, 1927, and that company employees numbering 20,000 during full time operation, will be increased proportionately.

The Hudson Motor Car Co. has increased its shipments to a basis of 1,200 cars a day compared with the former schedule of 900 daily. It s expected that the increased rate will be maintained through the balance of this month and into June.

Lucien Rosengart, general manager of the Peugeot Automobile Co., of France, has announced plans for the establishment of a branch in Detroit to produce small light cars. The cars are only 9 ft. 9 in. long and 3 ft. 2 in. wide. They will compare in prices with the lowest priced American cars, and will be manufactured on a large scale. Production will be started within three to nine months, and it is planned to produce 100 cars a day for a start.

Personals

F. C. BLANCHARD is now associated with the Rivett Lathe and Grinder Corporation, of Boston.

HEMAN ELY has been elected vice-president and treasurer of the Servel Corporation of New York.

E. J. COSGRAVE is now representing the Gustave Fox Co., of Cincinnati, in the Detroit territory.

W. R. KLINKICHT has been elected chairman of the Cincinnati Chapter of the American Society for Steel Treating.

CLIFTON REEVES and staff, consulting and operating industrial engineers, announce the removal of their New York offices from 150 Broadway to 341 Madison Ave.

H. L. MARGETTS, assistant superintendent of the Western division of the Michigan Central Railroad, has been promoted to the position of superintendent of the Canadian division.

CHARLES B. OFFICER has been appointed chief engineer for the Sullivan Machinery Co., of Chicago. Mr. Officer was formerly assistant to the president in engineering matters.

CHARLES T. AMEEL, formerly with the Ford Motor Co., in Detroit, has been appointed salesman and demonstrator in Detroit for the Walter S. Ryan Co., specializing in Societe Genevoise locating and jig boring machines.

WILLIAM G. PRAED has been elected chairman of the Indianapolis Section of the American Society for Steel Treating. Other officers elected to serve for one year are Carleton B. Edwards, vice-chairman, and Clarence H. Beach, secretary-treasurer.

H. B. CARLSON, formerly secretary and treasurer of the Mid-West Machines Tool and Supply Co., of Davenport, Iowa, has disposed of his interests in the concern and has organized the Carlson Machinery Co. R. R. Englehart and H. R. Bartlett, of the Sieg Co., are associated in the new company.

CEDRIC J. PRIEBE has been transferred to Washington, D. C., as district sales engineer for SKF Industries, Inc., of New York. His headquarters are at the Chastleton, 16th and R Sts., N. W. Mr. Priebe was formerly a member of the editorial staff of *American Machinist*.

JARVIS WILLIAMS, JR., vice-president and works manager of the Remington Arms Co., Inc., Bridgeport, Conn., has severed his connection with the company, and will be succeeded as works manager by J. E. Brennan. Mr. Williams had been with the Remington company since 1907 and was appointed works manager in 1917. Mr. Brennan's connection with the company covers a period of 38 years.

ROBERT NEAL PIPER has been appointed sales engineer for the Cincinnati Shaper Co., of Cincinnati. He was formerly sales representative in Buffalo for the National Automatic Tool Co.

Business Items

The Contractors Equipment Co., of Detroit, has added the Ord finishing machine to its line of equipment.

The Superior Bearing Co. has opened a plant at 821 South East St., Indianapolis, Ind.

The Stockbridge Machine Co. has opened a New York sales office at 149 Broadway. P. K. Dayton is in charge.

The Lincoln Brass Foundry, 911 North Wilbur St., South Bend, Ind., will move its plant to Mishawaka, Ind., in the factory formerly occupied by the Werra Aluminum Co.

The Standard Asbestos and Cork Co., of Tulsa, Okla., has been appointed district distributor for "Adamant" fire brick cement, manufactured by the Botfield Refractories Co., of Philadelphia.

The Federal Tool and Alloy Steel Corporation, of New York City, has filed a certificate in the office of the Secretary of State changing its corporate name to the Swedish Iron and Steel Corporation.

The North & Judd Manufacturing Co. has sold its plant and property at New Haven to the Standard Realty and Liquidation Co. This plant, purchased seven years ago from the W. & E. T. Fitch Co., has been found to be unnecessary under the present production schedule of the company.

The Black & Decker Manufacturing Co., Towson, Md., announces that all outstanding first mortgage bonds remaining from the bond issue of the company, Dec. 1, 1920, payable in ten years' time, are now being called for payment June first. The fact that these bonds are being paid off four years and a half in advance of maturity is an indication of the rapid growth and financial standing of the company.

The Van Dorn Electric Tool Co., of Cleveland, has taken over the sales and servicing of the line of valve refacing machines, valve seat reamers and electric drill and grinder equipment manufactured by the Van Norman Machine Tool Co., of Springfield, Mass. The latter company will continue to market directly its line of piston turning and grinding machines, piston, and connecting-rod reaming machines.

Negotiations have been completed for the merger of the Lamson Sessions Co. and the Kirk Latty Manufacturing Co., of Cleveland, manufacturers of bolts and nuts. The combined organization will have resources of over six million dollars and will employ twelve hundred people. Active management of the plants will be in the hands of George Case, Lamson Jennings, Roy Smith and M. McIsaac. W. M. Horton is in charge of production and Charles Longfield in charge of sales.

Plans to manufacture bearings for railroad equipment involving an expenditure of more than $1,500,000 in plant expansion have been announced by the Timken Roller Bearing Co. The site of the new plant is adjacent to the present factories of the Timken company at Canton, Ohio. Plans already have been drawn for the new building and the necessary equipment arranged. Work will be started immediately on the project and the new factory expansion will be ready by January first.

The Stanley Works, New Britain, Conn., has acquired the American Tube and Stamping Co., Bridgeport, Conn. At a meeting of the directors of the latter company on May 17, the offer of the New Britain concern was accepted. The American Tube and Stamping Co. operates two steel plants at Bridgeport. By acquiring the Bridgeport plant the Stanley company will have its own steel supply. The Stanley Works plans to abandon the rolling mill it has operated at Bridgewater, Mass., in about a month. The machine shop and foundry unit of this plant will be retained.

Forthcoming Meetings

Society of Automotive Engineers. Summer meeting, French Lick Springs, Indiana, June 1 to 4. John Warner, manager of meetings, S. A. E., 29 West 39th St., New York City.

Iron and Steel Exposition. Annual exhibit of fuel, electricity, machinery and safety under the auspices of the American Society for Steel Treating, Hotel Sherman, Chicago, June 7, 8, 9 and 10. Secretary, Mr. Kelly, Empire Bldg., Pittsburgh, Pa.

National Association of Purchasing Agents. Eleventh annual convention and exposition, Ambassador Hotel and Auditorium, Los Angeles, Calif., June 9 to 12. W. L. Chandler, secretary, Woolworth Bldg., New York.

American Railway Association. Annual meeting of the Mechanical Division (Master Car Builders and Master Mechanics), Atlantic City, N. J., June 9 to 16. V. R. Hawthorne, secretary, 431 So. Dearborn St., Chicago.

Railway Supply Manufacturers' Association. Annual convention and exhibit in conjunction with Division V, Mechanical, of the American Railway Association, Young's Million Dollar Pier, Atlantic City, June 9 to 16. J. D. Conway, secretary, 1841 Oliver Bldg., Pittsburgh.

Society of Industrial Engineers. Thirteenth national convention, Bellevue-Stratford Hotel, Philadelphia, June 16, 17 and 18. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago.

American Society for Testing Materials. Haddon Hall Hotel, Atlantic City, N. J., June 21 to 25. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia.

American Society of Mechanical Engineers. Spring meeting, Palace Hotel, San Francisco, Calif., June 28 to July 1. Chairman of convention, Warren H. McBride, the California and Hawaiian Sugar Refining Co., 215 Market St., San Francisco.

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 1, 2 and 3. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foremen's Supply Association. Annual exhibit in connection with the annual convention of the American Railway Tool Foremen's Association, Chicago, Sept. 1, 2 and 3.

Machine Tool Exhibit. Sixth annual exhibition of machine tools at the Mason Laboratory, Yale University, under the auspices of the New Haven Section, A.S.M.E., the mechanical engineering department of the Sheffield Scientific School, and the New Haven Chamber of Commerce, Sept. 7 to 10. Administrative office, New Haven Machine Tool Exhibit, 400 Temple St., New Haven, Conn.

American Society for Steel Treating. Eighth national steel and machine tool exposition, Municipal Pier, Chicago, Sept. 20 to 24. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

American Foundrymen's Association. Second international foundrymen's congress, Detroit, Sept. 27 to Oct. 1, under the auspices of the American Foundrymen's Association. R. E. Kennedy, secretary, 909 W. California St., Urbana, Ill.

The Weekly Price Guide

Rise and Fall of the Market

WITH the exception of a fairly active demand for tubular products, the current iron and steel market is slow. Pig-iron prices remain unchanged from last week's levels; scrap is declining sharply; furnace coke is off 15c. and foundry, 25c. per ton at Connellsville. Lower quotations are also reported on the principal hot-rolled products at mills. Steel bars are $1.90@$2; shapes and plates, $1.80@$1.90 per 100 lb., f.o.b. Pittsburgh. The minimum applies on large tonnages only and represents a decline of about 5c. per 100 lb. on plates and 10c. on shapes and bars.

Compared with May 14 levels, non-ferrous metals, except zinc and antimony, are lower at New York warehouses. Scrap brass, copper and lead are cheaper; linseed oil is down 0.1c. per lb.

(*All prices as of May 21*)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	23.26
Virginia No. 2	28.67
Basic	22.26
CHICAGO	
No. 2 Foundry local	22.50
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.05
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	21.27
Basic	21.27
Bessemer	21.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.25
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.40@2.50	3.89	3.25	3.50
No. 12	2.45@2.55	3.94	3.30	3.55
No. 14	2.50@2.60	3.99	3.35	3.60
No. 16	2.60@2.70	4.09	3.45	3.70
Black				
Nos. 18 to 20	3.05@3.15	4.30	3.90	3.90
Nos. 22 to 24	3.10@3.20	4.35	3.95	3.95
Nos. 26 and 27	3.15@3.25	4.40	4.00	4.00
No. 28	3.25@3.35	4.50	4.10	4.10
Galvanized				
No. 10	3.50@3.60	4.65	4.25	4.25
Nos. 12 to 14	3.60@3.70	4.75	4.35	4.35
No. 16	3.75@3.85	4.90	4.50	4.50
Nos. 18 to 20	3.90@4.00	5.05	4.65	4.65
Nos. 22 to 24	4.05@4.15	5.20	4.85	4.80
Nos. 26 and 27	4.20@4.30	5.35	5.10	4.95
No. 28	4.50@4.60	5.65	5.25	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	58%	45%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	55%	42%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — Decimal	B.W.G. and Fractions	Outside Diameter in Inches — ¼	⅜	½	⅝	1	1¼	1½
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.30	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.10	3.10
Soft steel bars (base)	3.24	3.00	3.00
Soft steel bar shapes (base)	3.24	3.00	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.20	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60@65%	55%	50%

Electric welding wire, New York, ⅜", 8.25c.; ¼", 7.85c.; ⅛" to ⅛", 7.35c. per lb. *Flat, ⅛"@¼-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15 12½
Tin, 5-ton lots, New York			62.62½
Lead (up to carlots) E. St. Louis	7.55	New York	8.40
Zinc (up to carlots) E. St. Louis	6.87½	New York	7.80

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	15.00	....	16.00
Copper sheets, base	22.50	22.50	22.50
Copper wire, base	19.25	16.50	16.00
Copper bars, base	22.12½	22.12½	21.87½@22.12½
Copper tubing, base	24.25	24.25	24.25
Brass sheets, base	18.87½	18.87½	18.87½
Brass tubing, base	23.50	23.50	23.50
Brass rods, base	16.62½	16.62½	16.62½
Brass wire, base	19.37½	19.37½	19.37½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	12.00	12.60@12.95	12.27
Solder (½ and ½), (case lots)	38.50	42.00	38½@42½
Babbitt metal, delivered, New York, cents per lb.:			
Genuine, highest grade			76.00
Commercial genuine, intermediate grade			55.00
Anti-friction metal, general service			31.50
No. 4 babbitt (f.o.b.)			13.62½
Nickel, f.o.b. refinery, cents per lb.:			
Ingots 31 00 Electrolytic 38.00 Shot 32.00			

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	11.75@12.25	11.25	10.75@11.25
Copper, heavy, and wire	11.00@11.50	11.50	10.25@10.75
Copper, light, and bottoms	9.50@ 9.75	9.75	9.50@10.00
Heavy lead	6.75@ 7.00	6.50	6.25@ 6.75
Tea lead	4.50@ 4.75	5.00	5.00@ 5.50
Brass, heavy, yellow	7.00@ 7.25	7.25	7.00@ 7.50
Brass, heavy, red	9.25@ 9.75	9.50	8.25@ 8.75
Brass, light	6.00@ 6.25	6.00	6.25@ 6.75
No. 1 yellow rod turnings	8.25@ 8.50	8.00	7.50@ 8.00
Zinc	4.50@ 4.75	4.00	4.00@ 4.50

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.45	$11.50
"A" Grade:				
IC,	14x20	9.70	9.40	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.75@8.00	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.13@0.17½	$0.18	$0.15@0.20
Cotton waste, colored, per lb.	.10@ .14	.17	.12@.17
Wiping cloths, washed white, per lb	.18	36.00 per M	.16
Sal soda, per 100 lb. keg	2.05	2.25	2.75*
Roll sulphur, per 100 lb	3.60†	3.35	4.25‡
Linseed oil, per gal., 5 bbl. lots	.84	.98	.87
Lard cutting oil, 25% lard, per gal.	.55	.50	48
Machine lubricant, medium-bodied (55 gal. metal bbl.), per gal.	.35	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs. † Per 150 lb. lot. ‡In 425 lb. barrels

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb	.1662½	.1662½	.1587½
Solder (½ and ½)	per lb.	.385	.4012½	.395
Cotton waste	per lb.	.13@.17½	.13@.17½	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	7.00
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	55	.55	.55
Machine oil	per gal.	35	35	35
Belting, leather, medium	off list	40–5%	40–5%	30–10%
Machine bolts up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.56	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.45	1.49
Cloth	3.55	3.55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		2.85@ 3.00
Coke, prompt foundry, Connellsville	per net ton		4.00@ 4.50
White lead, dry or in oil	100 lb. kegs		New York, 15.25
Red lead, dry	100 lb. kegs		New York, 15.25
Red lead, in oil	100 lb. kegs		New York, 16.75

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1½ and 1½x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ½x½-in., 2c. each. Discount 70% for $\frac{5}{16}$-in and smaller and 65% for ½-in. and larger.
Case hardened ½x½-in., 6c. each, less 50%.

Rivets, button heads, ¾-in., ½-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4½-in. $5.00* per 100 lb. at New York warehouses; cone heads same sizes, $5.20* per 100 lb. Rivets, $\frac{1}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb for 1½ to 2-in. long, all diameters, 25c.; ¾-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ¾-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Mich., Detroit—Detroit Cab Co., 565 East Larned St.—miscellaneous tools and equipment for proposed 2 story, 125 x 195 ft. garage and repair shop. Estimated cost $160,000.

Mo., St. Louis—Stinson Adding Machine Improvement Co., 321 South Grand Blvd., complete equipment including drill presses, milling machine, stamping machines, lathes, etc., for proposed 2 story, 130x250 ft. addition to factory. Estimated cost $100,000.

N. Y., Brooklyn — Electric Welding Co., 744 Court St.—punch and shear, double end ½ in.

O., Canton—Timken Roller Bearing Co., Harrison Ave. S. W.—machinery for the manufacture of bearings for well drilling machinery, electric appliances, road building equipment, mine cars, steel mill equipment, etc., for proposed extension to factory. Estimated cost $1,000,000.

O., Columbus — Dept. of Water Works, C. B. Hoover, Supt.—special machinery for proposed 3 story, 100 x 135 ft. machine shop. Estimated cost $100,000.

Man., Selkirk—Manitoba Steel Foundries Ltd.—machinery and equipment for foundry to replace fire loss. Estimated cost $300,000.

Que., Campbell's Bay—J. D.D St. Pierre general equipment including welding outfit for proposed addition to machine shop.

Que., Kenogami—Denis Fortin & Frere—lathe and other equipment for proposed auto repair shop.

Que., L'Islet—J. A. Belanger—drill press and miscellaneous tools for auto repair shop.

Que., Magog—W. Hamel—drill press and other equipment for proposed auto repair shop.

Que., St. Christine—S. Lavallee—equipment for proposed addition to foundry.

Que., St. Sylvestre — A. Letourneau — small lathe, press and miscellaneous tools for machine shop.

Que., Val Jalbert—J. Gauthier—general machine shop equipment.

Australia, Melbourne—Victorian Government Railways, will receive bids until June 23 for one multiple spindle drilling machine with equipment, also until July 14 for two capstan lathes with equipment.

Opportunities for Future Business

Calif., Los Angeles—Advance Auto Body Works, is having revised plans prepared for the construction of a 2 story, 125 x 146 ft. factory at Mission Road and Macy St. Estimated cost $40,000. H. Bean, Central Bldg., Archt. Noted Feb. 11.

Calif., Los Angeles—A. P. Mitchel, et al, awarded contract for the construction of a 4 story, 104 x 155 ft. garage and auto sales building at 12th and Figueroa Sts. $175,000. Noted Apr. 29.

Calif., Oakland—Black & Decker Mfg. Co., 75 Fremont St., San Francisco, manufacturers of electric shop tools and equipment, will soon award contract for the construction of a 1 story factory at East 10th St. and 6th Ave., here. W. H. Weeks, 369 Pine St., San Francisco, Archt.

Conn., Hartford—Royal Typewriter Co., 150 New Park Ave., has tentative plans for the construction of a factory. Estimated cost $40,000.

Ill., Canton — International Harvester Co., 606 South Michigan Ave., Chicago, Ill., awarded contract for the construction of a 1 story, 39 x 160 ft. addition to factory, here.

Ill., Elgin—Elgin National Watch Co., will soon award contract for the construction of a 5 story, 28 x 500 ft. and 6 story, 55 x 132 ft. additions to factory. G. E. Morris, Sherwin Bldg., Archt. Noted Sept. 17, 1925.

Ill., Rockford — Greenlee Bros. Co., awarded contract for the construction of a 1 story, 80 x 110 ft. foundry on Columbia Ave.

What This Section Is

Machinery Requirements and Industrial Construction is a reliable machinery market, because every item is reported first-hand by our own correspondents, scattered over the United States and Canada. These leads are verified by our men. We do not use newspaper clippings, nor do we listen to any hearsay or rumors. These sales leads are as accurate as our men can make them, and as timely as weekly publication will permit.

This market is for *American Machinist* subscribers. It covers the same machinery fields as does the paper. Here will be found inquiries for machine tools, presses, hammers, welding, forging and heat treating equipment, and other machinery for the shop.

Here also will be found reports of proposed industrial construction, where sooner or later machinery will be needed.

Are you making the most of the opportunities listed here?

Ill., Rockford—J. W. Miller Incubator Co., 2500 Latham St., awarded contract for the construction of a 1 and 2 story, 50 x 250 ft. factory. Noted Apr. 15.

Ind., Anderson—General Motors Corp., 3044 West Grand Blvd., Detroit, Mich., is having plans prepared for the construction of an office and factory building here. Estimated cost $2,000,000.

Ind., Evansville—Chicago & Eastern Illinois Ry. Co., 66th St. and Union Ave., Chicago, Ill, plans the construction of machine shops and round house, here. Estimated cost $500,000. L. C. Hartley, Ch. Engr.

Ia., Dubuque — Julien Dubuque Garage Co., c/o S. F. Weisir, 12 South Grandview St., plans the construction of a 3 story garage and repair shop at Third and Locust Sts. Estimated cost $200,000. Architect not selected.

Kan., Newton—Atchison, Topeka & Santa Fe Ry. Co., plans improvements to rail mill and frog shop. Estimated cost $175,000. H. W. Wagner, Topeka, Ch. Engr. (Eastern Lines).

Mass., Lynn—M. Galaid, 540 Beach St., Revere, is receiving bids for the construction of a 1 story, 85x220 ft. repair and service garage at 234 Chestnut St., here. Estimated cost $70,000. E. Earp, 333 Union St., Lynn, Archt. Noted May 20.

Mass., Newton (Boston P. O.)—Rosen & Levine, c/o S. E. Moffie, 51 Cornhill, Boston, Archt., awarded contract for the construction of a 1 story repair and service garage at Washington and Hovey Sts., here. Estimated cost $45,000.

Mass., Somerville (Boston P. O.)—Boston Elevated Ry. Co., Park Square Bldg., Boston, is receiving bids for the construction of a 2 story, 45x145 ft. garage and repair shop here. Estimated cost $85,000. A. J. Blackburn, c/o owner, Archt. Noted May 13.

Mich., Grand Rapids—American Seating Co., awarded contract for the construction of a 90x459 ft. foundry, 100x258 and 45x59 ft. pressed steel shops, etc., all 1 story.

Minn., St. Paul—Dept. of State Highways, 1246 University Ave., will soon award contract for the construction of new maintenance and repair shops at Bemidji, Brainerd and Detroit, Minn.

N. J., Bridgeton—Herman Z. Cutler Co., 505 Arch St., Camden, awarded contract for the construction of a 1 story, 140 x 250 ft. auto radiator repair shop here.

N. J., East Burlington (mail Burlington)—U. S. Cast Iron Pipe & Foundry Co., 71 Broadway, New York, N. Y., is having plans prepared for the construction of a 1 story foundry here. Estimated cost $65,000. Private plans.

N. J., Perth Amboy—Middlesex County Vocational School Bd., New Brunswick, will receive bids until June 3 for the construction of a vocational school, including shops, etc., here. Estimated cost $250,000. Greisen & Tuzik, Perth Amboy, are architects. Noted Dec. 31, 1925.

O., Bellaire—The Bellaire Neff Bus Co., N. O. LaRoche, Pres., is having plans prepared for the construction of a 2 story, 120 x 200 ft. garage and salesroom. Estimated cost $150,000. The Austin Co., 16112 Euclid Ave., Cleveland, Archt.

O., Canton—Wheel Products Corp., recently organized, plans the construction of a factory for the manufacture of auto tire rims. Estimated cost $50,000.

O., Cincinnati—Crosley Radio Co., Colerain Ave., awarded contract for the construction of a 6 story, 75x260 ft. manufacturing plant on Sassafras Ave. Estimated cost $300,000.

O., Cleveland—W. J. Wefel, 5716 Euclid Ave., Archt., is receiving bids for the construction of a 2 story, 40x140 ft. addition to factory for The Domestic Electric Co., C. A. Duffer, Pres., 7209 St. Clair Ave. Estimated cost $50,000. Noted Mar. 18.

O., Columbus—Dept. of Public Works & Highways, S. F. Schlesinger, Dir., is having plans prepared for the construction of a 2 story, 100x200 ft. garage and repair shop. Estimated cost $100,000. Private plans.

Pa., Philadelphia—A. E. Pausser, 1055 Locust St., awarded contract for the construction of a 2 story, 42 x 60 ft. machine shop at 738 South 42nd St. Noted Apr. 8.

Wis., Milwaukee — Heil Co., 26th and Montan Aves., awarded contract for the construction of a 1 story, 100x300 ft. machine shop.